February, 1972 / 75 cents

BROADCAST ENGINEERING

the technical journal of the broadcast-communications industry

A HOWARD W. SAMS PUBLICATION

Radio warning system status report

page 16

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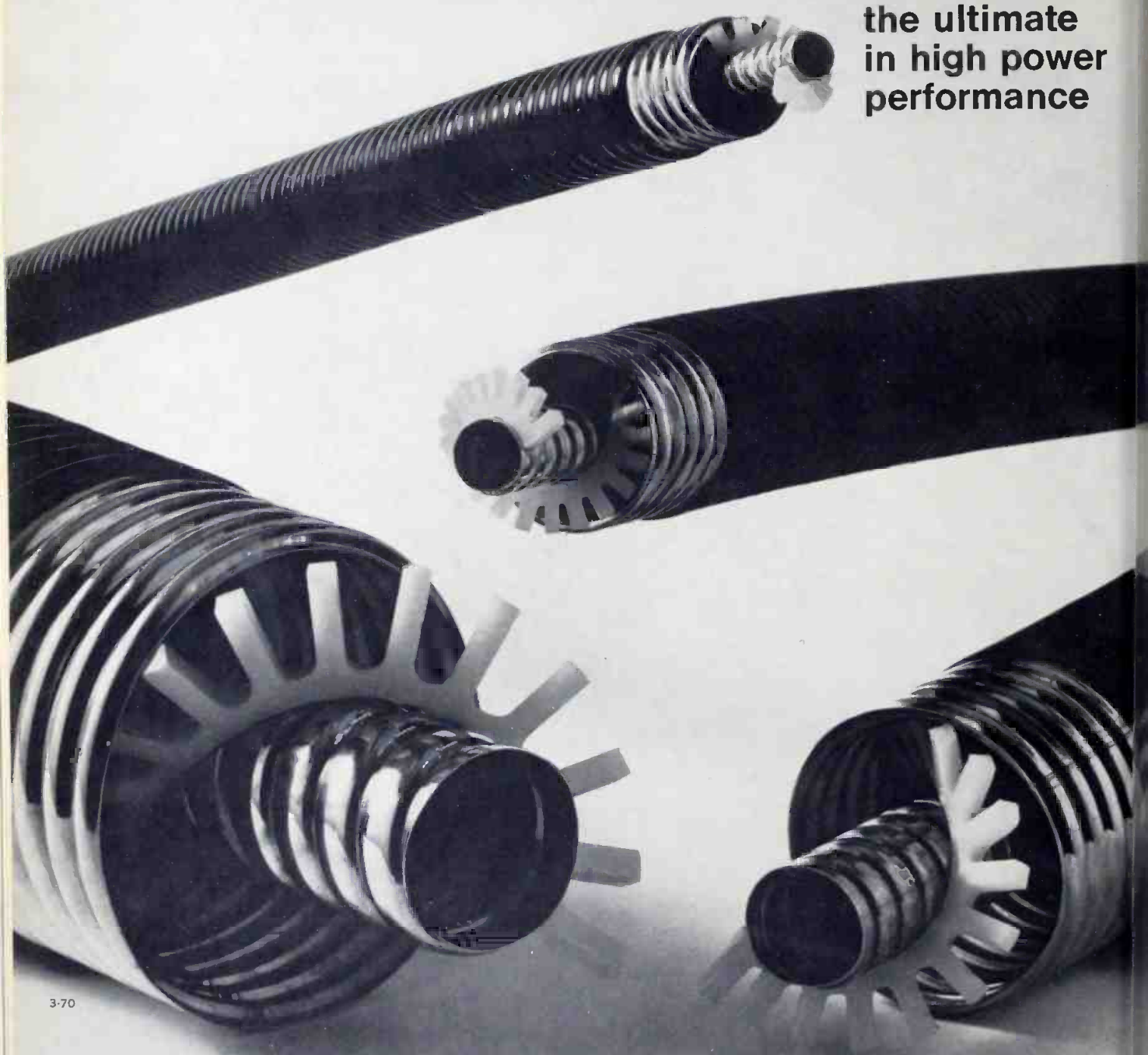

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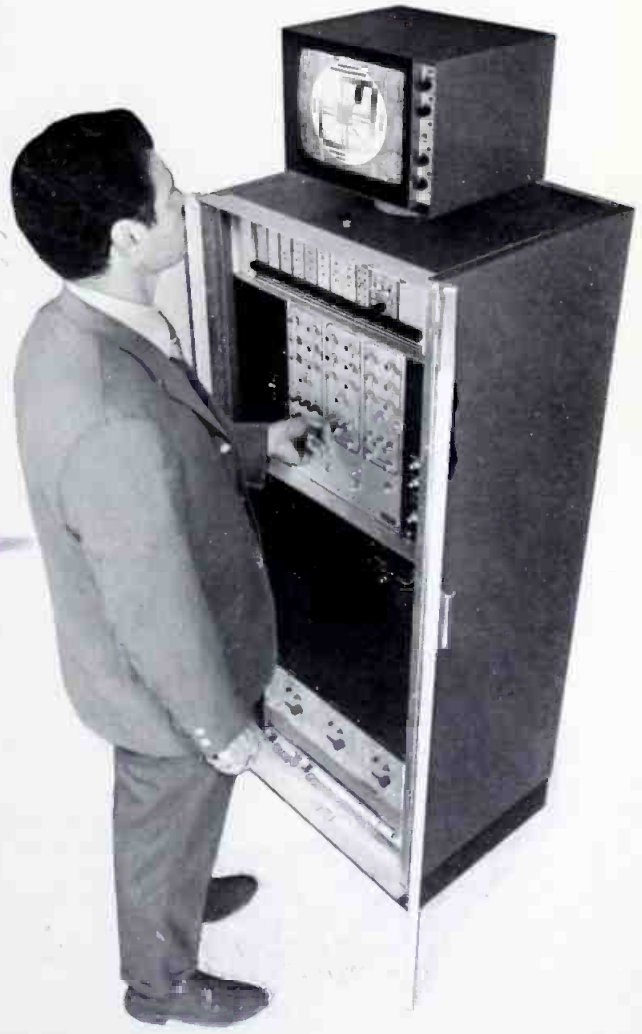

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February, 1972 • Volume 14, No. 2

BROADCAST engineering

The technical journal of the broadcast-communications industry

in this issue...

ABOUT THE COVER

The cover this month shows an inside view of a van and crew on remote. The big story this month is the OTP policy on emergency broadcasting. See article on page 16. Photo by Ampex.

DEPARTMENTS

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DIRECT CURRENT FROM D. C.

FEBRUARY, 1972

by Howard T. Head

TV Remote Control Rules Go Into Effect Unchanged

The Commission has denied several petitions for re-consideration of various aspects of the new rules governing the remote control of television broadcast transmitters. The three major networks, as well as several individual licensees, had complained about the required five-day-a-week transmitter inspections, the requirement for observing the VIT signal every thirty minutes, and the components of the prescribed VIT insertion signal (See Dec., 1971 Broadcast Engineering).

Even these various reconsideration petitions disagreed among themselves as to what should be substituted for the presently-required VIT waveform. The absence of such agreement left the Commission little choice but to prefer the waveform already adopted. On the matters of half-hourly logging and daily inspection, the Commission emphasized that the primary reason for the adoption of the new rules had been to improve color picture quality, and that considerations of economies in transmitter operation were only secondary.

The Commission did, however, provide additional time for UHF ETV stations to comply with the new rules when operating by remote control, and extended the date to April 30, 1974. The present deadlines of April 30, 1972 for commercial UHF stations and April 1, 1972 for commercial VHF stations remain in effect. Several new remote-control authorizations under the new rules have already been issued.

Canadian Domestic Satellite Plans Well Under Way

While the FCC continues to delay action on pending proposals for a domestic satellite relay system for the U.S., Canada is pressing ahead with its own plans. The Canadian organization, known as Telesat Canada, is a private corporation chartered by Parliament in 1965 and subject to the usual common-carrier regulation. Ground stations are now under construction and the components of the satellite are being tested. Present schedules call for a launch of the satellite from Cape Kennedy before the end of 1972. Regular operation is expected to begin shortly thereafter.

The Canadian satellite system will be used for the relaying of television, radio, and telephone communications. Satellite relaying is of particular importance in Canada, particularly in the remote areas of northern Canada which presently have no other reliable means of communication.

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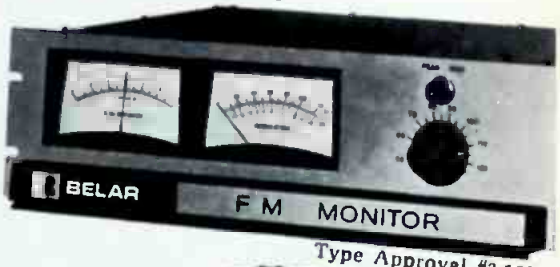

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(Continued from page 4)

Controversy Continues on Picture Coding System

The Commission has granted International Digisonics Corp. (IDC) additional time to submit technical studies in support of its proposals for relaxed tolerances on the transmission of coded picture information (See Nov., 1971 D.C.). In the meantime, the television networks and individual stations have been studying the present coded transmissions by means of pulse-cross displays which, by grouping the four corners of the picture near the center of the kinescope, make observation of the coded corners relatively simple.

The observations are generally indicating that even under the proposed relaxed rules, the coded material as it is now being transmitted falls outside of the permitted areas for a substantial portion of the time. CBS has given notice that after February 1, 1972, it will no longer transmit material carrying the IDC code, an action which has brought loud protests from IDC. IDC has asked the Commission to permit the employment of codes falling outside of the permitted area for periods of time not to exceed one second in duration.

New Height Determination Technique to be Permitted

The Commission has announced that applicants for land mobile base station licenses in the 470-512 MHz band (shared with TV broadcasting), who must make a showing of the effective antenna height, may do so by employing a computer method originally developed by the Commission. This method employs computer tapes developed by the U.S. Air Force, which reduce ground elevation data on topographic maps to a computer equivalent. Comparisons by the Commission have indicated that the accuracy of the method compares quite favorably with conventional manual methods.

The principal advantages of the computer technique are that answers may be obtained at only a fraction of the time and cost of present methods. The new method has obvious applicability to FM and TV broadcasting, but for the present the Commission is confining its use to land mobile applications.

The Commission has also proposed to permit land mobile base stations in the 470-512 MHz band to employ effective antenna heights in excess of 500 feet above average terrain, the presently prescribed limit. A reduction in power would be required for effective antenna heights above 500 feet to avoid any possibility of increased interference.

Short Circuits

Congratulations are in order for veteran FCC'er Harold Kassens who has been appointed Assistant Chief of the Bureau...A VHF television translator in Michigan has been ordered off the air to protect a new UHF station...Several CATV systems in the Midwest which have proposed distant signal carriage permissible under the Commission's "letter of intent" to Congress (See Sept., 1971 D.C.) have been reminded that the proposed new rules are not yet in effect.

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LETTERS TO THE EDITOR

AM: Old Fashioned, But Still Good

Dear Editor:

Compatible single side band for the AM broadcast band as suggested by Mr. Floyd's letter in November *BE*, is not a practical solution to the AM interference of coverage problem.

CSSB *cannot* be demodulated by the universally used diode detector. Both sidebands *must* be present for low distortion demodulation. In the case where the sideband and carrier amplitudes are the same, the demodulated output of a diode will contain 22 percent 2nd harmonic distortion. In older CSSB systems this was overcome by generating distortion products at the transmitter out of phase with those generated by the diode to produce a resultant signal of low distortion. Theoretically this would work if the receiver IF bandwidth was sufficient—requiring careful tuning—and the phase and amplitude of the transmitted distortion information cancelled at the diode.

The only way to demodulate a SSB+carrier signal is by using exalted carrier or product detector circuitry such as the commercial communications systems use—something not found in entertainment receivers. Old fashioned or not, AM is still pretty good.

Francis Sherwood
Mgr. Audio Engineering
Radio Free Europe
Munich, Germany

Exciter Identified By BE Reader

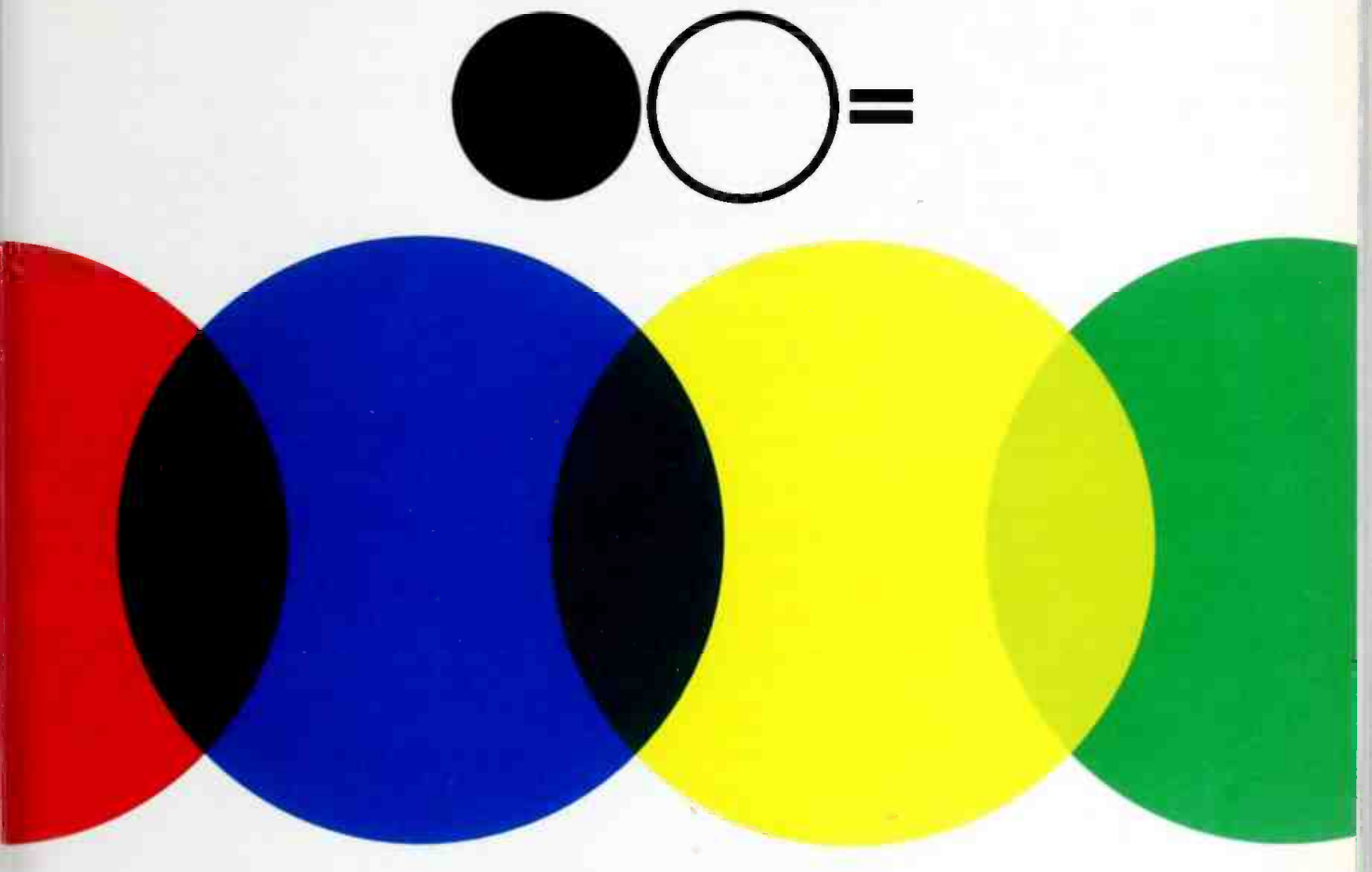
Dear Editor:

In the December issue of *BE*, Letters to the Editor, there was a letter "Exciter Identification Help Needed." We have advised Mark Worley of KAMU-TV that the exciter is a Standard Electronics exciter. An instruction book and

(Continued on page 10)

SEND YOUR LETTERS TO THE EDITOR to Broadcast Engineering 1014 Wyandotte Kansas City, Mo. 64105

THE ABTO EQUATION:



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The only problem with the Abto Equation is that it's hard to believe. Seeing is still believing. Arrange a demonstration. Come skeptical. Get the facts in black and white. You'll leave thinking color.

Demonstrations will be arranged in the order in which requests are received. We anticipate a deluge.

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Letters

(Continued from page 8)

schematic have also been sent to Mr. Worley.

We appreciate the comment that "the unit is well built with quality components..." Thank you for the service your fine publication provides to both the broadcaster and to us, the manufacturer.

Bill Zillger, Sales Mgr.
Standard Trans. & Elect. Co.
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Elephant Needed With Light Step

Dear Editor:

I am at a loss how a broadcast station is to maintain a good weight on a record when that recording is warped or otherwise damaged. I have almost had to hire an elephant to weight the tone arm to keep the stylus from bouncing on the disc. I would assume that this method is disastrous to stereophonic disc.

Another related problem is the fact that people entering the control room, and perhaps stepping too heavily, cause the needle to bounce off the record (this occurs on weights lighter than 2 grams). The tone arm I am using is a Viscous damped Gray arm with a Stanton cartridge.

Randall B. Sturm, CE
KWYR AM-FM
Winner, S.D.

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National Radio Month Theme For 1972 Is: "Sound of Service"

The National Association of Broadcasters announced the selection of "Radio...the Sound of Service" as the 1972 National Radio Month theme.

James H. Hulbert, NAB executive vice president for public relations said the theme was chosen "to reflect the continuing relationship between the nation's radio stations and the people they serve."

National Radio Month, an annual, month-long event celebrated each May, is designed to acquaint the public with the many and varied services radio provides. The observance is sponsored jointly by NAB, its nationwide radio membership and the four national radio networks.

"I'M MOVING IN! YOU SPEND ALL YOUR TIME HERE ANYWAY!"

INDUSTRY NEWS

Remote Control Extension

UHF noncommercial educational television broadcast stations have been granted time until April 30, 1974, by the Commission, to comply fully with recently adopted rules governing the remote control operation of UHF and VHF television stations (Docket 18425).

The remote control regulations, which amended Part 73 of the rules, were approved by the Commission in two actions—a First Report and Order, adopted March 17, 1971, stating the basic requirements for remote control of VHF and UHF television stations, and a Second Report and Order, adopted August 18, 1971, specifying regulations for the use of vertical interval test signals by remote controlled stations.

The Commission authorized additional time for UHF ETV stations to meet certain requirements of the new rules in response to petitions for reconsideration of the First Report and Order, but denied any other relief. Petitions for reconsideration of the Second Report and Order were also denied.

(Continued on page 12)

FM Translator Permits Granted

The first applications for construction permits (CP) for FM radio translator stations, in the FM radio translator service created by the Commission in September 1970, have been granted by the Chief, FCC Broadcast Bureau.

Granted simultaneously, on December 21, 1971, were CPs to: Wisconsin Christian Broadcasting Foundation, Inc., to serve Viroqua, Wis., by rebroadcasting WRVB-FM, Madison, Wis., on 106.3 MHz (BPFT-1); Communications Investment Corporation, to serve Evanston, Wyo., by rebroadcasting KQMU, Salt Lake City, Utah, on 105.5 MHz (BPFT-4); and KSL, Incorporated, to serve Brigham City, Utah, by rebroadcasting KSL-FM, Salt Lake City, on 105.5 (BPFT-8).

Although more than twenty CP applications for FM translator stations have been filed in recent months, action on some of them was delayed because of the lack of type accepted equipment. Several manufacturers have recently indicated that they intend to seek type acceptance for their FM Translators.

Each of the three granted CP applications proposes operation with peak transmitter output power of one watt. Under the rules, FM translator stations in areas west of the Mississippi (except central and southern California) would be permitted to operate with ten watts peak transmitter output power.

The translators are used to improve a broadcast station's signal in sections in its service area where it may be weak because of terrain or other conditions. A translator is actually a low power broadcasting station which receives the station's signal and rebroadcasts it.

The First Report and Order required stations to make transmitter inspections at least five times each week, although weekly inspections were permitted if the station was equipped for auxiliary operation with at least 20 percent of authorized power in the event of main transmitter failure. UHF stations, formerly operated by remote control under rules requiring transmitter inspections only once a week, were to become subject to the five-a-week rule requirements within one year of the effective date of the rules.

Petitions for reconsideration of the First Report and Order, filed by a number of UHF licensees and by the National Association of Educational Broadcasters, asked that all UHF be exempted from the new inspection requirement or be granted a five year grace period.

In denying these requests, the Commission said that the best overall service to the public will be provided when remote controlled stations all operate in full compliance with the amended rules. It noted, however, that UHF ETV stations have unique financing problems (the larger part of their funds come from state legislative action or from Federal grants, the Commission said, and a long lead time is usually required for obtaining additional amounts) and found good cause for giving educational stations a longer time to meet the more frequent inspection requirement. UHF ETV stations may conduct transmitter inspections at intervals of one week, whether or not the stations have facilities for auxiliary operation, until April 30, 1974.

Commercial UHF stations will have until April 30, 1972, to comply with the regulations, as originally proposed.

Petitions for reconsideration of the Second Report and Order were filed by the three major television networks, Kaiser Broadcasting Corp. and Forward Communications Corp., objecting to certain characteristics of the test signals that were adopted, the degree to which the test signals occupy the vertical interval and to requirements for observing and logging the test signals.

Denying these requests, the Commission stated that while there might be some redundancy in the prescribed test signal format, it did not seem to place a substantial burden on the broadcaster, or, at this time, to cause "needlessly great occupation of vertical interval space which might otherwise immediately be devoted to other useful purposes." "The availability of all signals affords the broadcaster a considerable degree of flexibility in developing effective procedures for the surveillance of transmitting system performance."

Equal Opportunities In Broadcasting For Women

Section VI of various broadcast application forms (FCC Forms 301, 303, 309, 311, 324, 340, and 342) which licensees use to file equal employment opportunity programs designed for Blacks, Orientals, American Indians, and Spanish-surnamed Americans has been amended by the FCC to include equal employment opportunity programs for women (Docket 19269). The rule amendment becomes effective February 4, 1972.

Comment on the amendment was invited in a rule making notice released on June 28, 1971, in response to a request from the National Organization for Women (NOW).

The Commission said that almost all of the comments filed in response to the notice supported the NOW proposal. Opposition to the change was expressed by the National Association of Broadcasters (NAB) and Mrs. Virginia F. Pate, President and General Manager, The Chesapeake Broadcasting Corporation.

NAB and Mrs. Pate argued that licensees are already required to establish equal employment opportunity programs designed to prevent discrimination on the basis of sex and that it would be an additional burden for the licensee to require that specific programs concerning women be filed with the Commission. Asserting that no pattern of discrimination against women in the broadcasting industry has been established, NAB said

that since a specific program cannot be drawn up for every kind of minority group, a line must be drawn somewhere—and it should be drawn to exclude women from the filing requirement. In its comment on the NOW proposal to add the full text of Section VI to the rules (73.125, 73.301, 73.599, 73.680 and 73.793), NAB stated that the provisions of Section VI are flexible guidelines which are not precise enough to be stated as rules, and that adding the section to the rules will not enhance its availability to the public.

The Commission, while agreeing with NAB that specific programs cannot be developed for every conceivable group or subgroup, said that in considering a requirement of specific programs and reporting requirements "it is necessary to focus on those groups which comprise a substantial portion of the population and which have in the past suffered from discrimination in employment." The Commission pointed out that women make up over 50 percent of the population, that the history of employment discrimination against them "is amply demonstrated by the comments in this proceeding," and it is "fully appropriate" that broadcasters provide equal employment opportunities for women "as well as for Negroes, Orientals, American Indians and Spanish-surnamed Americans."

The Commission said that the guidelines set out in Section VI are flexible in their application to particular situations, "and we do not intend to change their character in this respect." It said that it saw no undue burden which would outweigh the substantial public benefit of requiring broadcasters to articulate the programs and file them with the Commission.

Stating that its general practice is to avoid encumbering the rules with lengthy application forms, the Commission said it did not consider it appropriate to repeat the text of Section VI in the rules or make the guidelines "more rigid by casting them as formal rules." However, a provision generally stating the requirement that equal employment opportunity programs be filed was added to appropriate sections of the rules.

Minnesota ITV Goes To System With Talkback

More than 700 hours of college credits are being beamed for the first time by the University of Minnesota this semester to off-campus students through a new half-million dollar two-channel microwave TV network completed here by Genesys Systems, Inc., a Palo Alto, California communications firm.

The new TV network called UNITE (University-Industry Television for Education), went on the air with 20 courses on September 27.

Richard A. Swalin, dean of the University's Institute of Technology said the system was provided to meet the growing demand for mid-career education in graduate and advanced level courses in science and engineering. "The new instructional TV network," he stressed, "makes it possible for the University to significantly augment its continuing programs of off-campus education."

The ITV system, designed and installed by Genesys, is being funded through long term agreements for participation by those industries in the area which are the prime users of the system.

The firms include IBM, Univac, Honeywell, Northern States Power Company and a government agency, the U.S. Bureau of Mines Research Center.

The Minnesota network was approved by the FCC to broadcast in an assigned band of channels at microwave frequencies ranging from 2500 to 2690 megahertz known as the Instructional Television Fixed Service (ITFS) band. An FM radio talk-back capability from each off-campus site allows every student, on or off-campus, to participate in discussions with the instructors as if they were all in one classroom.

Genesys Systems was founded in 1967 to develop instructional television networks for universities and government. The company also designs and installs microwave systems for industrial uses.

The NAEB Elects Two Broadcasters As Directors

Fred J. Rebman, executive vice president of WJCT-TV Jacksonville, Florida, and Jack D. Summerfield, general manager of KPBS-FM-TV San Diego, California, have been elected to four-year terms on the board of directors of Educational Television Stations, a division of the National Association of Educational Broadcasters.

A graduate of Michigan State University, Rebman has been professionally involved in television production, development and administration. In these capacities he has been at various times affiliated with Sports Network Inc.; the U.S. Army; the American Management Association; the Chamber of Commerce; the U.S. Office of Education; and the Southern Network. In addition he has served as an advisor on cable television to the Federal Communications Commission, the White House, cities, major corporations and several members of Congress.

Summerfield, who holds degrees from the University of Texas, has served as chairman of the National Advisory Committee, Educational Communications System; project officer, Corporation for Public Broadcasting; consultant, Ford Foundation; general manager, WRVR New York; producer, production manager, FM manager and assistant general manager, WGBH-FM-TV Boston; radio-TV producer and production manager, University of Texas; and faculty member, Columbia University Graduate School.

Summerfield's broadcast productions have won Peabody, DuPont, Armstrong and other major awards.

KIRO-FM Joins The Move To Quad Stereo

Last November KIRO-FM teamed with KIRO-TV and AM in presenting the first series of Four Channel Happenings in the Puget Sound Area. Since April the Seattle Bonneville outlet has used the Electro Voice Encoder and Decoder, which electrically processes four channel source material such as tapes into two channels at the broadcast end and then reprocesses them back into four channel programming at the receiving end. This system is compatible with existing equipment and FM broadcasting standards.

Listeners at home continue to receive the complete signal and programming of the station. However KIRO-FM's participating stereo dealer sponsors hold open-house demonstrations for the public to hear the four channel broadcasts weekly.

KIRO-FM's pioneering in four channel broadcasts is also Sunday mornings when the acoustic properties of the Salt Lake Tabernacle and its famous Choir are enhanced by the quad sound.

Send Your Industry News To Broadcast Engineering For Better Coverage

"We interrupt this program..."

The Status of Radio Warning Systems In The United States

By Charles C. Joyce, Jr., Asst. Director, OTP

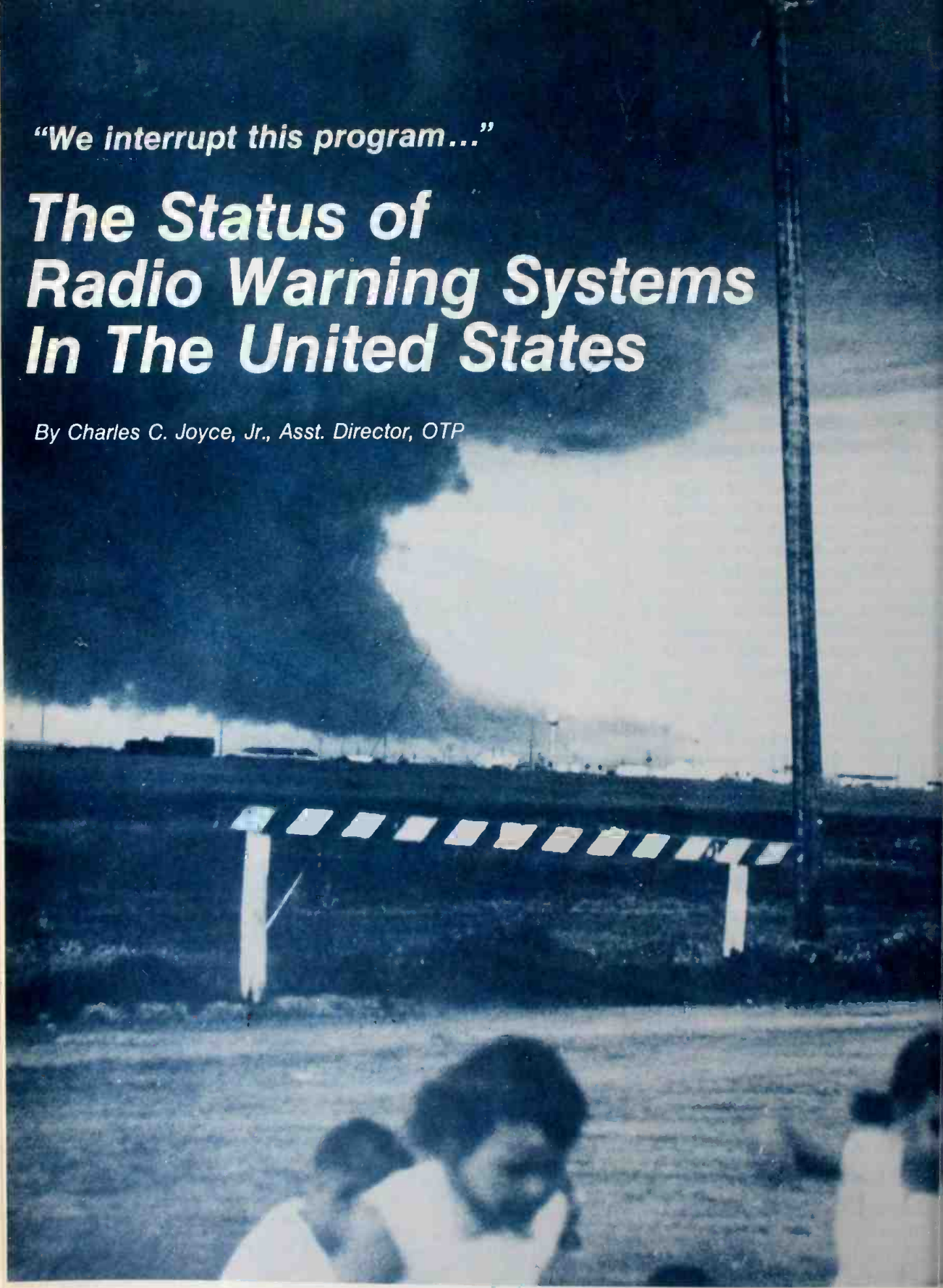

Fig. 1 Shown here is a tornado which struck Fargo, N. D. in June, 1967. (Photo by NOAA

Studies of nuclear attack, as well as experience with natural disasters, provide convincing evidence that adequate warning is one of the key factors in saving lives in such situations. For over twenty years, the Federal Government has provided financial assistance to state and local governments for the installation of community sirens for warning purposes. However, the coverage of sirens is limited and their effectiveness at night is low.

For years, the Federal Government has studied a variety of ways of using broadcast communications systems—radio and television—to get warning information directly to the listener. In the early post war period, CONELRAD was instituted for this purpose. CONELRAD provided emergency information to the public on two frequencies, 640 and 1240 kilohertz. All other commercial broadcasting was suspended. Commercial stations were used to broadcast on these two frequencies, using a transmission pattern designed to prevent enemy bombers from homing in on radio transmissions.

The EBS System

By 1963, the radio had ceased to be a useful means of navigation for enemy attackers, so the CONELRAD system was replaced by the Emergency Broadcast System (EBS). The EBS permits selected stations to broadcast at normal power on their assigned frequencies during emergencies, to allow the President to address the nation and to provide supplementary emergency information from Federal, state, and local agencies. Civil defense warning announcements were incorporated in the procedures for activating the EBS, although sirens continued to be the primary civil defense warning system.

While commercial broadcast stations can quickly relay a warning to the listening audience, they cannot reach people whose radio or television sets are turned off. Hence, means have been sought for using radio techniques to sound an alarm in every home at any time of the day or night. Research on a means of transmitting a signal through power lines was begun in 1951, culminating in the development of the National Emergency Alarm Repeater (NEAR) system. This system had to be abandoned, however, due to increasing interference from new electrical devices in the frequency band which NEAR was using.

When NEAR was abandoned, efforts were focused on the development of a system of over-the-air transmission of a special warning signal which would turn on (technically, de-mute) a receiver in the home (or car, or boat) and transmit a specific warning message. Three different approaches were pursued independently by three Federal agencies.

Decision Information Distribution System

The Office of Civil Defense (OCD) developed the Decision Information Distribution System (DIDS), which used ten government-owned low frequency transmitters to provide nationwide coverage. DIDS planners envisioned the use of separate low-frequency receivers for institutions including Federal, state and local government agencies, and a low frequency receiver incorporated in a standard radio or television set for reaching the general public.

The National Oceanic and Atmospheric Administration (NOAA, formerly ESSA) augmented its nationwide weather teletype network with a network of VHF radio transmitters planned ultimately to cover coastal areas and the "tornado belt." Owners of VHF receivers can receive continuous weather information on the NOAA channel. A new receiver with a demuting feature has recently been developed which would permit NOAA to "turn on" the receiver with a special warning signal. Currently this receiver costs about $150.00 and very few have been sold.

Fig. 2 The DIDS receivers will automatically deliver an alerting voice or teletype message to selected key locations or can sound a warning by sirens on command sent by unattended transmitters.

At the request of the Federal Communications Commission, its National Industry Advisory Committee (NIAC) developed a signalling technique which would enable a commercial broadcast station to de-mute a specially designed radio receiver if it were tuned to that station. Incorporating this technique into the EBS could also provide a widespread warning capability.

A fourth approach to warning, using the telephone system, was also under consideration by OCD. By the end of 1970 it became clear that unless the public was to be faced with a bewildering array of different warning systems, some fundamental decisions would be necessary. A review was undertaken within the Federal Government, led by Clay T. Whitehead, Director of the President's Office of Telecommunications Policy in the Executive Office of the President, to determine what system or systems could best and most economically meet the need to warn the general public of the United States in an emergency.

The first step in the review was to establish the goals that a warning program should meet. While there are a variety of pertinent technical goals, the following factors most significantly affect the choice of systems.

Warning System Goals

First, the warning system must be capable of reacting in seconds.

Studies have shown that timeliness is critical for civil defense warning. Delays of 5 to 10 minutes could greatly diminish the benefits of a nationwide public warning system. A response time of 30 seconds was established as the objective to be met by any warning system designed to meet civil defense needs.

Second, the warning system must be operative 24 hours a day. The critical deficiency in current warning systems is coverage during the night. The principal advantage of a radio warning system capable of reaching into the home is that it can wake people up.

Third, any 24-hour warning system designed to provide weather and natural disaster warnings must be highly selective. Such warnings are valid only for relatively small geographical areas. The widespread dissemination of a weather warning would unnecessarily disrupt the lives of many who would be totally unaffected by the particular threat. Unless such false warnings can be held to the absolute minimum, large segments of the public could become disenchanted with the warning system and would disable their receivers.

Finally, to assure public confidence, the system must be highly reliable. Unobtrusive means of testing should be available to assure the owner that his receiver continues to function. False activation of the receiver must be virtually eliminated.

It became obvious early in the review that only one system had, up until this time, been thoroughly planned and engineered to meet these requirements. That was DIDS. With the nationwide coverage provided by its ten government controlled transmitters, DIDS would be capable of alerting over 98% of the U.S. population within 30 seconds, at any time of the day or night. Use of its addressing feature would permit DIDS to selectively address any of 5,000 or more individual geographic areas. While there were some uncertainties with respect to DIDS, there were equal or greater uncertainties associated with all of the other candidate systems which were under consideration. The principal question addressed in the review was whether any other system could come close to meeting the objectives at a cost significantly lower than the expected costs of the DIDS system.

System Costs

A few simple calculations showed that the cost of any nationwide warning system receiving a high degree of acceptance would be dominated by receiver costs. At costs ranging from $5 to $25 per receiver, a system with one receiver in each of the 66 million American households would entail an expenditure within the range from a third of a billion to one and a half billion dollars for the receivers. The transmitter system costs of roughly $35 million for DIDS, or a lesser figure for the use of existing private broadcast facilities, are not a major factor in the selection of the most economical warning approach. It would be a disservice to the American public to minimize the transmitting cost of the warning system while ignoring the much higher costs of an effective distribution of receivers.

Unfortunately, the problem had not been looked at this way before, and sound comparative receiver costs studies were not available. Only very rough cost estimates were available. However, a qualitative comparison of the functions to be performed by the receiver in different systems allowed a determination of relative costs sufficient to accomplish the purpose of the review.

Certain alternatives were readily dismissed as being inferior to DIDS. A study of the feasibility of using the telephone system for warning had been completed by the telephone company for the Office of Civil Defense. That study revealed that the use of the telephone system to provide a comparable warning service would be at least as expensive as DIDS, and would provide coverage to only about 85% of the U.S. population. In addition, such use of the telephone system would disrupt normal communications at critical times. All things considered, the use of the telephone system did not appear to provide an attractive alternative to DIDS for national warning.

Next we considered the possible use of AM or FM radio broadcast stations, television broadcast stations, or expansion of NOAA's VHF warning system. Because of the large number of transmitters which would have to be linked and controlled for any of these approaches, it was clear that there would be no advantage to any of these systems unless some way could be found to make the warning receivers significantly cheaper than a DIDS receiver. Two possible ways to do this were analyzed: (1) by using the geographical selectivity inherent in FM, TV or VHF coverage patterns instead of using the digital address scheme included in DIDS, or (2) by use of a "tunable" receiver.

The Receiver

The DIDS system would achieve the necessary geographic selectivity by including in each receiver an address decoder capable of distinguishing 5,000 or more different digital addresses. The inclusion of this address decoder adds to the cost of the DIDS receiver, as does the need to provide a means for changing addresses whenever a household moves from one addressing area to another. Since FM, TV and VHF signals are limited to a radius of 25 to 40 miles, a degree of selectivity could be provided which might serve as an alternative to the digital addressing scheme. However, there would only be about 500 different addressable areas in such a scheme. On the average, the minimum area warned in this case would be at least ten times larger than the minimum area addressable in DIDS. This represents a considerable loss in selectivity.

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The DIDS receiver is a fixed-tuned receiver. Whether packaged separately or included in another piece of home entertainment equipment, it would require its own antenna, front end, and demodulator, in addition to the address decoding and filter circuits. If AM or FM broadcast stations were used, an alternative would be to use the normal "tunable" receiver front end, simply introducing the filter and control circuitry necessary to identify and decode a warning signal. An AM or FM radio designed for use as a warning receiver in this manner would, when not in use, be in a powered but muted condition. If the correct warning alert signal were transmitted by the radio station to which the receiver was tuned, it would activate the filter circuitry and de-mute the set. The elimination of the fixed-tuned front end would reduce the cost of adding this type of warning feature to a conventional radio set. However, this approach has operational disadvantages.

The tunable receiver would provide a warning only if it is tuned to a station which is on the air when the warning is to be sounded. Since many popular stations go off the air some time during the evening, radio or television sets left tuned to these stations would not be activated in the middle of the night by a warning signal unless those stations were left in a standby condition at all times and could be remotely activated by the Federal Government. This could be overcome if the homeowner were willing to retune his radio to a 24-hour station before turning it off at night. This is expecting too much of human nature.

Careful consideration of these factors led to the conclusion that those alternatives to DIDS which had the potential for significant savings in receiver costs also entailed losses of selectivity or reliability which could seriously compromise the effectiveness of the warning system.

Receiver Distribution

Another factor affecting the usefulness of a national warning system is the means by which receivers would be distributed to the population at large. Unless the warning receiver is accepted into the home, the system will not be effective at night and will probably achieve little more in the way of warning coverage than the existing siren systems.

Studies made several years ago indicated that a warning receiver sold separately would not achieve a very significant market penetration. This led to consideration of the possibility of incorporating the warning receiver into an item of home entertainment equipment. This would achieve certain savings in manufacturing costs due to the sharing of such common items as power supply and speaker. Distribution costs would also probably be reduced relative to the cost of distributing a stand-alone item. Television sets are the obvious choice as a "carrier" for the DIDS receiver, because of the very high penetration of television sets into the home market, and because the percentage impact of the DIDS receiver on the overall cost of the television set would be small. Legislation requiring the incorporation of a warning receiver in every new television set would, within ten years, achieve a very high penetration of warning receivers, and would assure that the economies of mass production would be fully exploited in the manufacture and distribution of warning receivers.

There are, however, overriding disadvantages to such legislation. Part of the problem is psychological. The thought of the government's voice booming out from a television set conjures up images of Orwell's famed novel *1984*. Commentators have already raised this specter, although the analogy is very poor. "Big Brother" appeared in sound and picture, preempted all other programming, and was capable of listening in on individual households. The DIDS system would provide only voice transmission of warning messages, is clearly limited to one-way transmissions to the home, and does not preempt other programming. If included in a television set as described, the DIDS receiver would be disabled whenever the television set is on. Hence the listening television audience would receive the warning through the cooperation of the private broadcast industry.

Fig. 3 A low frequency antenna, similar to planned prototype of the DIDS.

There is no precedent for the government requiring every citizen to purchase a device solely for the purpose of allowing the government to communicate with the citizen. However valid this approach may be in consideration of the warning mission, it will surely be objectionable to many on general policy grounds. American society today is faced with considerable uncertainty about where the rapid evolution of communications and information handling technology is taking us. The Office of Telecommunications Policy, in coordination with other elements of the government and with the private sector, was established to clarify these issues and to provide improved mechanisms by which the nation can direct the use of these technologies into socially desirable channels. Until a clearer national understanding and consensus about the role of these technologies emerges, however, legislation of the kind we have been

alking about is bound to be misnderstood. Accordingly, a conscious decision has been made by his Administration that any warning receiver entering the home should be purchased voluntarily by the individual citizen.

It is recognized that this decision means at least initially, that he warning system will not achieve a very high overall penetration because of the decisions of individual nome owners about their participation in the system. A change in he national climate or the clear appearance of an external threat could, of course, radically change his initial situation. For the present, however, the responsibility of the government is basically twofold. First, to provide warning signals which can be received by any citizen who is willing to buy the warning receiver. Second, to design the system so that the home warning receiver can be as inexpensive as possible. The price of such a receiver should be so low that every household can afford one. Economic discrimination in the distribution of warning receivers would undoubtedly be recognized as grossly unfair.

Government Actions

In accordance with these conclusions, the government of the United States is proceeding with several related actions. The first operational DIDS warning transmitter is being constructed in Maryland and will be completed in mid-1972. This transmitter will provide for a thorough operational test of the DIDS system with its selective addressing capability. In addition, the Office of Civil Defense is undertaking design studies for home receivers in order to fully validate the design concept and to provide a firmer basis for determining the ultimate cost of these receivers. Cost performance tradeoffs are being reviewed once again to assure that every feature which adds to the cost of a home receiver is truly desirable in the context of a voluntary home warning program. These actions reflect the commitment of this Administration to achieve the maximum benefits of communications technology for warning purposes while permitting individual citizens to retain freedom of choice with respect to both economic and operational participation in the system.

Fig. 4 The hurricane's worst killer comes from the sea. Surge heights along flat coasts can bring catastrophe. The greatest loss of life during hurricanes is caused by flooding due to the storm surge. Adequate warning enables the public to evacuate in time. (Photo by NOAA)

A word of clarification may be in order with respect to the Emergency Broadcast System. There seems to be a widespread public belief that the Emergency Broadcast System is the primary means of warning the general public of an attack. Actually, the purpose of the Emergency Broadcast System is to permit the President to reassure the Nation of the continuity and determination of its government under conditions of extreme emergency. The plan for the Emergency Broadcast System permits Federal agencies, including the Office of Civil Defense, to use the system to pass other emergency information once activated by the President. The Office of Civil Defense had therefore planned to use the system on this basis to pass emergency information and instructions.

As a result of a recent review of the Emergency Broadcast System, the White House, the Federal Communications Commission, and the Office of Civil Defense have agreed to remove the warning function from the Emergency Broadcast System. The Office of Civil Defense will make separate arrangements for the transmission to news media of information concerning any attack upon the United States. The Emergency Broadcast System will be designed to perform optimally its function of allowing the President to address the American people at times when it is appropriate for him to do so. The Office of Telecommunications Policy, in conjunction with the FCC and with the government and private organizations involved in the EBS, will continue to seek improvements to the EBS which will maximize its effectiveness in serving that purpose. ▲

Time Coordination Plan For Directional Adjustments

Here is a time-coordinated plan for directional antenna adjustments where manpower is limited and equipment is minimal.

By J. G. Rountree, P.E.*

Ideally, a directional antenna will produce the desired pattern when the operating parameters are adjusted to theoretical values. While careful attention to the overall installation of a directional antenna system and particularly to the phase and current monitoring system will result in the production of something close to the desired pattern on the initial tune-up, the sad fact is that such tune-up is only a point of departure for further adjustments.

The usual next step in adjusting a directional antenna system is to make sufficient measurements to determine in what direction and to what extent the radiated fields differ from the desired fields. Having such data, the consulting engineer adjusting the antenna system can re-design the system to determine what changes in current and phase relationship will be necessary to achieve the desired pattern. Such parameters are then set up, and any further change in the pattern is usually achieved by experimental means.

*Consulting Engineer, Austin, Texas.

Ideal Conditions

Ideally, these further adjustments are made by positioning assistants at each monitoring point, each equipped with a field-intensity meter and with two-way radio communication to the engineer at the transmitter location. It then becomes a relatively simple matter to "talk in" the monitoring points to the desired values of field intensity. This arrangement is equally applicable to the readjustment of an existing antenna which has drifted out of adjustment.

Unfortunately, however, there frequently is not sufficient manpower or equipment to carry out this idealized procedure, and it becomes necessary to resort to other, more expedient methods. It is the purpose of this article to discuss one such method, a time-coordinated plan of procedure.

Time Coordination

Under this plan, it is assumed that manpower and equipment are minimal, so that only two persons are available to do the work—one to adjust the phasor controls and one to make field-intensity measurements—and that two-way radio equipment is not available. If additional field sets and qualified manpower are available, or if two-way radio equipment is available, the work can be speeded up by their judicious use.

The essential elements of the plan are that both the person adjusting the phasor and the person making the field-intensity measurements have coordinated timepieces and have a definite schedule to follow. Then, at the specified time, various adjustments are made to the phasor, and the resulting effect of each adjustment is noted at the measuring point. The person making field measurements then proceeds to other measuring points of interest, and the procedure is repeated.

Phasor Controls

It goes without saying that the phasor controls must have counter dials, so that a control can be re-set to a specified point. Unfortunately, such dials have some play or backlash, so that it becomes necessary to adopt a standard direction of turning to eliminate the effect of such shortcomings. One practice which is easily remembered is always to turn the dial in the direction of increasing numbers in approaching a desired setting. Thus, if a number lower than the initial setting is desired, the dial is turned to an even lower number, far enough below the desired number to completely overcome backlash, then the dial is turned in the direction of increasing numbers to the desired setting.

Typically, it has been found that only a fraction of a turn, about two-tenths of a turn above and below the initial setting, is sufficient to determine the effect of moving a control but not so great that the system will go completely "ape."

Unavoidably, changing the phasor controls will change the common-point impedance. Usually, however, such changes are small enough to be inconsequential if

Fig. 1 Phasor adjustments are made according to a carefully coordinated time schedule.

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Fig. 2 Field intensity measurements are made in coordination with phasor adjustments.

the changes in phasor settings are small, and frequently it is found that only the reactance, not the resistance, of the common point will change.

In any event, after the complete series of tests have been run, phasor settings producing meaningful changes in field intensity must be re-examined to determine whether the change in field resulted from actual changes in the pattern or from changes in the amount of power fed into the antenna system. In general, however, a transmitter provides a surprisingly steady source of constant-power output. The effect of phasor changes can be checked most readily by provision of a common-point impedance bridge or by insertion of an operating impedance bridge at the common point[1].

Test Timing

The amount of time allowed between changes in the phasor settings is a matter of individual choice. On the one hand, the changes should be made rapidly enough to minimize the effect of drift in calibration of the field meter and change in line voltage at the transmitter. On the other hand, they should not be made so rapidly that they cannot be recorded reliably by the person measuring field intensity. About 15 to 20 seconds seems to be about right. Certainly, not over 30 seconds should elapse between changes. In order not to be interrupted during the procedure, the one controlling the phasor should silence the telephone, "squawk box," or visitors.

At each measuring point, the one reading the field meter should immediately re-calibrate the meter at the conclusion of a series and then repeat and record the last reading. This will give an indication of the rate of drift of calibration of the field meter during each series.

Interpreting Results

Table 1 gives a typical series of measurements, and Table 2 shows the analysis of this series. With such information, it becomes relatively simple to determine the changes required at the phasor to achieve a desired change in field intensity at a measuring point.

A closing word of caution is in order: This procedure, like all procedures dealing with adjustment of a directional antenna system, should be undertaken only by or under the direction of, an engineer trained and experienced in the theory and practice of directional antennas. The effects of undirected and unorganized "knob twiddling" are often awesome to behold—and expensive to correct.

TABLE 1
FIELD INTENSITY AT MONITORING POINTS

Time	Control	Setting	MP #1	MP #2	MP #3
To T	Phase 2	057	40.5	158	42.5
T (....)	Phase 2	059	40.9	159	41.0
T + 15 sec.	Phase 2	055	40.1	154	44.5
T + 30 sec.	Phase 2	057	40.4	158	42.3
T + 30 sec.	Phase 3	099	40.4	158	42.3
T + 45 sec.	Phase 3	101	44.7	155	44.5
T + 1:00	Phase 3	097	32.5	163	40.5
T + 1:15	Phase 3	099	40.2	158	42.0
T + 1:15	Power 2	029	40.2	158	42.0
T + 1:30	Power 2	031	40.2	156	40.9
T + 1:45	Power 2	027	40.2	160	43.7
T + 2:00	Power 2	029	40.2	157	41.8
T + 2:00	Power 3	062	40.2	157	41.8
T + 2:15	Power 3	064	39.4	155	39.8
T + 2:30	Power 3	060	37.9	159	43.7
T + 2:45	Power 3	062	40.2	157	41.8
Re-calibrate field meter			40.6	158	42.4

TABLE 2
BEHAVIOR OF FIELD INTENSITY AT MONITORING POINTS

Control setting	MP #1	MP #2	MP #3
Increase Phase 2	Increases	Increases	Decreases
Increase Phase 3	Increases	Decreases	Increases
Increase Power 2	No change	Decreases	Decreases
Increase Power 3	Increases	Decreases	Decreases

Footnote

[1] "Expanding the Impedance Bridge" by J. G. Rountree January 1970 BROADCAST ENGINEERING, Page 46.

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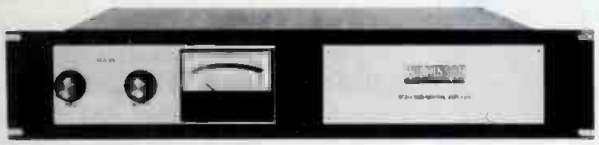

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A custom audio design for television

Backed by management, the KBTV engineers built an entirely new audio production system that challenged their talents and proved the value of broadcast engineering. By Les Dunn*

Fig. 1 The old KBTV conference room before starting work.

Fig. 2 The view from the audio operating position after completion.

■ The average television station large or small, sooner or later face the task of construction and instal lation of new or different facilities This station was no exception Early in 1970, it became apparen that KBTV was to have a new pro duction control room for use witl an existing studio. This discussio will cover the audio productio area and the design philosophy for it

A former conference room mea suring approximately 25 feet b 10 feet immediately adjacent to th studio and almost directly ove master control was made availabl Figure 1 is a "before" view. Th was divided to allow some 15 fe in length for video, leaving an are approximately 10 by 10 feet f audio. It was decided that by rai ing this area two feet, several enc could be accomplished. The vide monitors at the far end of the roo could serve both video and audi operators; one set of clocks woul suffice as the audio man coul easily see over the video area; an it would provide crawl space unde neath for bringing in microphon control, intercom, and trunk line to master control. Figure 2 show the view from the audio operati position after completion.

Limited Budget, Limited Time

The next question was of equi ment. With an unlimited budge unlimited time, or both, there a a number of ways to go. All ne custom-built equipment is the ea but expensive means. If time is no importance, the modular, do- yourself approach is the least e pensive. Having both limited fun and time narrowed our choi considerably.

A station of this size cann afford to have expensive equipme idle a good part of the time, as strictly production work. Neith must the audio be second-rate.

*Maintenance Supervisor, KBTV, Denver, Colo.

must, therefore, be quality equipment and able to serve as a live "on-air" control room as well as capable of show and commercial production work. At times it may serve as a regional feed point for the ABC television network. In addition, some film production had to be considered since the station has a film production subsidiary. After much study, it appeared a 24-input, 4-output console would be adequate. This immediately put us in the expensive category.

At the time bids were being taken, delivery of most audio equipment was 90 to 120 days. Adding installation time on top of this made this route intolerable. Smaller consoles at substantially lower cost were available off-the-shelf from some sources.

After much discussion and searching, it was decided that two consoles could be cascaded, and with some work by the station staff, a custom installation could be made. It was found that Philips Broadcast Equipment Corp. (Norelco) could deliver two MD12RF2 mixing desks with 12 inputs and 2 outputs each. Discussion with their engineers showed they could easily have their outputs paralleled, giving us just what we needed. Included in the desks were equalization available for any four of eight input channels, built-in cue and reverb, and talkback facilities with the necessary amplifiers.

The only variation from the standard factory console was the addition of two rows of switches for six projectors to feed two inputs, and two rows for VTR's to feed two other inputs, making it possible to mix two projectors or VTR's. They were ordered, and immediately upon delivery were put through exhaustive performance tests.

Getting to a Functional Design

The next project was to get the

Fig. 3 The standard Norelco MD12RF4 console.

Fig. 4 Herb Schubarth (at left) Director of Engineering for the Mullins Broadcasting stations and the author are shown here in the half completed facility.

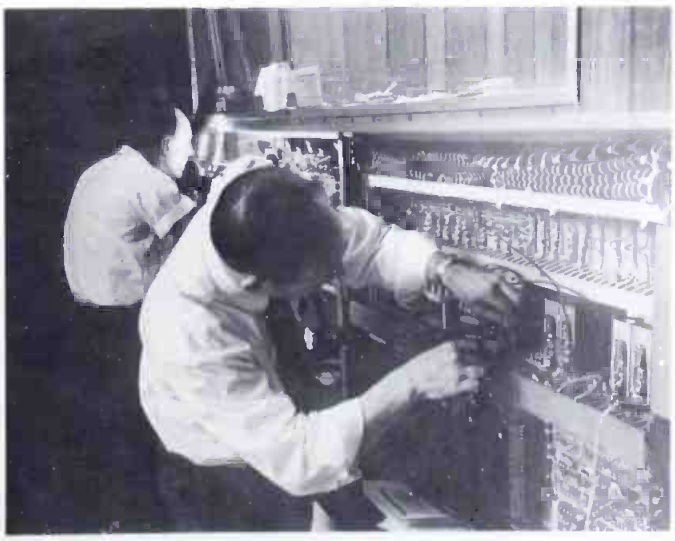

Fig. 5 Wiring in the final stages. Note that since the back of the consoles are raised and against the inside partition, they are easily accessible and can be serviced while standing.

Here are eight problems that cost you money

no control track

bad electronic edit

control track out of phase

head not locked to vide

unstable capstan

non-synchron switches

60 cycle drum error

low-band col played in hi-b

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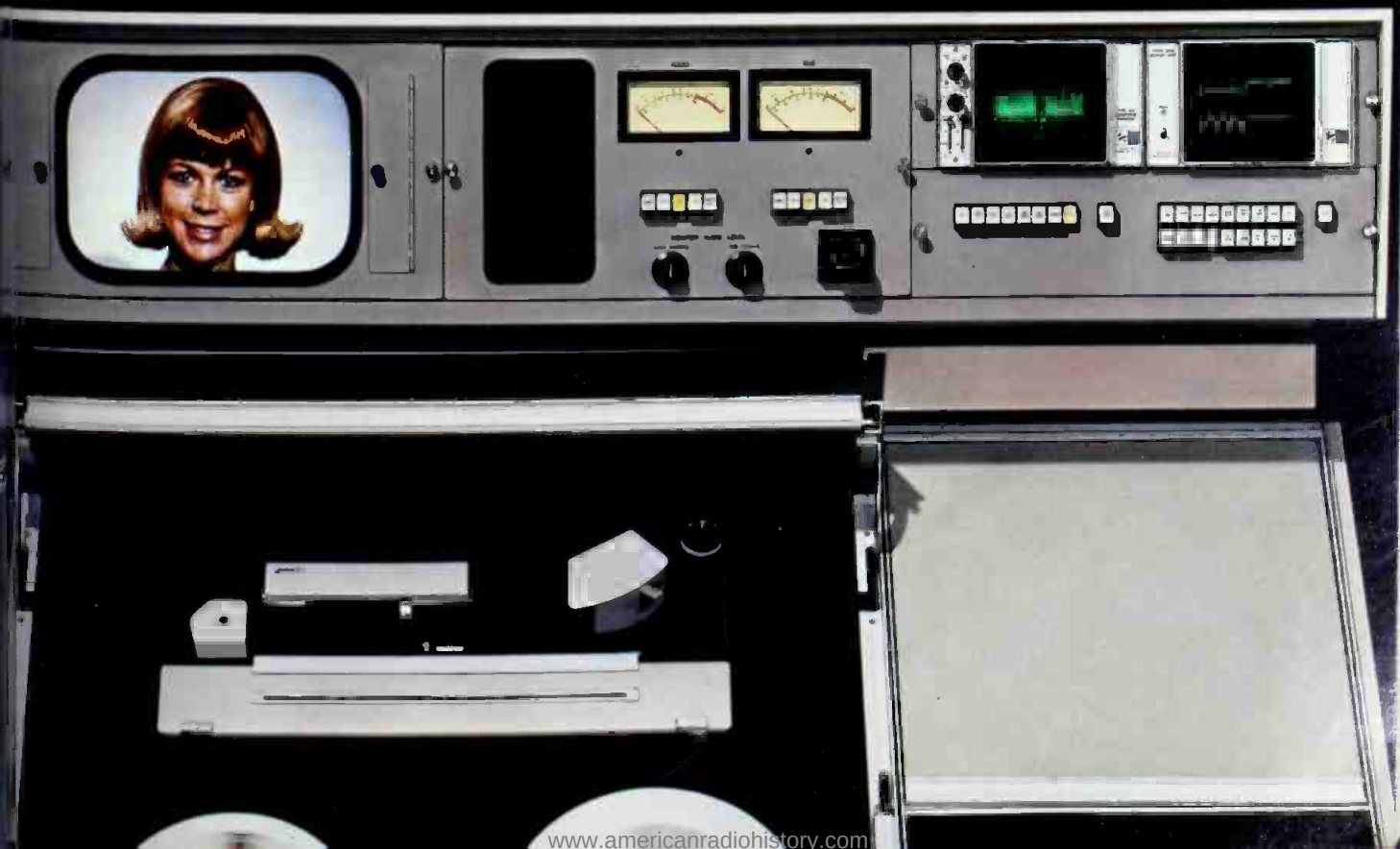
AMPEX

The monitor picture shown below is an unretouched photo taken directly from a color monitor; shown here on a standard AVR-1. A color monitor is available as an option.

AVR-1
the third generation recorder



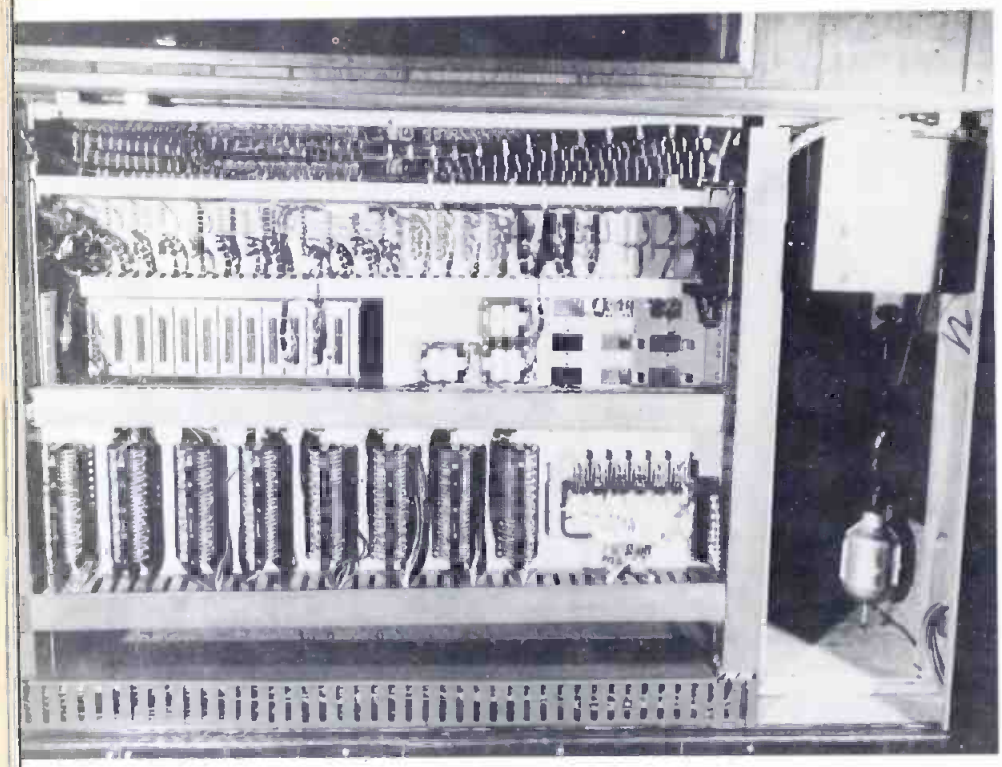


Fig. 6 A trouble light on a reel was installed, providing a work light and an outlet for soldering irons or vacuum cleaner.

Fig. 7 Reel-to-reel audio recorders, turntable, audio cart machines and reverb unit are to the right of the console.

consoles together in the most func
tional manner. There was mor
than a little apprehension as t
how well an operator could handl
a console nearly seven feet long
particularly in a fast-moving ai
show. The standard console i
delivered with the twelve inpu
channels to the left, the output i
the approximate center, the mon
toring block toward the right, an
the equalizers at the far right. Als
each console has the two V
meters in the approximate cente
in a vertical panel, with a cu
speaker toward the left, and the T
mic at the right. Obviously, thi
would be an awkward arrangemer
if two consoles were to be used.

With tongue-in-cheek, muc
courage, and more study, one co
sole was completely stripped. Th
VU meters were moved to the #
or right-hand console. The micr
phone and speaker were remove
from the #1 or left-hand consol
and eight rows of single-type patc
jacks were installed. Twenty fou
mic outlets were provided in th
studio, any twelve of them sele
table by key switches in the jac
field. Terminal blocks were mounte
on the lower rear of the #1 conso
so all connections to and from th
combination were readily acce
sible. With the consoles alread
raised two feet due to the rais
floor, wiring was much easier tha
at the top or bottom of a rack as
all too often customary.

Next, the input blocks of the #
console were moved to the rig
end, thus putting the 24 inputs a
jacent. The two output channe
of this console were moved to
in the same module housing as t
ones in the #2 console. This nc
put the four output channels a
jacent. The equalizer and monit
blocks were then moved to the
left, since they are used much le

This is all easier said than don
inasmuch as the input blocks ha
four connectors to plug into t
frame, and the monitor block whi
had to be moved had only three.
this entailed a good deal of cutti
and drilling. However, the co
soles are very straightforwa
cables easily identified, and t
prints readable, which eased

pain considerably.

The wiring of the jacks and terminal blocks, the cable runs, and grounding was all done with strict attention to good audio engineering practices. Figure 5 shows the installation under construction. All low-level cables were run in their own conduit to their own terminal blocks to separate low and high level cables completely. All microphone input channels are in one console. Jack fields were arranged the same way, and arranged so that under normal operation, no patch cords are ever necessary. Cables were all tied and run through plastic duct to give a neat, professional appearance. Easy access to both consoles, terminal blocks, jacks, and speaker monitor amplifiers is provided by removable panels held by magnetic catches. A trouble light on a reel was installed, providing a work light and outlet for soldering irons or vacuum cleaner as seen at the extreme right of Figure 6.

Audio Feeds

A scheme was designed to use audio distribution amplifiers, pads, and combining networks so that any one or combination of the four output channels could be fed to master control. However, the amplifiers used did not perform satisfactorily and the plan was discarded in the interest of time. This may be added at a later date if found desirable. As an alternative, one output channel is normalled to feed MC at all times, a second feeds a cartridge tape recorder, and the third and fourth feed two reel-reel audio tape machines.

The reverb unit was mounted in a cabinet beneath the cart machine. There was some feeling that this would not be the ideal place for it, but no problem has been observed.

One TB unit is used for the audio operator to talk to his director, the studio, and the video tape and projection areas. The other unit is remotely controlled by the director to talk back to his audio man, the studio, video tape, projection, and a studio cue headset.

The two monitor channels in the monitor block of the #2 console feed two Norelco MDM/MDL20 speaker-amplifier combinations which appear to us to outperform anything else available. One monitor channel of the monitor block of console #1 feeds an MDM/MDL20 combination in the video control area, and the other feeds an announce booth speaker.

Two reel-reel audio tape machines, an audio cart PB and REC/PB machines, and a Norelco turntable round out the equipment available. These are all mounted at the operator's right in an "L" shape as shown in Figure 7. The reverb unit is seen mounted directly below the cart machines. The reel-reel machines were inclined slightly for easier operation and visibility.

The completed #1 console is shown in Figure 8. The #2 console is pictured in Figure 9. The small panel in the foreground of Figure 9 is a remote control panel for the reel-reel and cart machines, placing the machines at the operator's fingertips. The two removable console desks were replaced with one long formica-covered desk as seen in Figure 2.

The room is walnut panelled with the custom-built cabinets covered with matching formica. The console jack field is also formica covered. Jack designations were done by a local engraver with white lettering on walnut formica. The input and output blocks are also identified with white lettering engraved on black backing for optimum visibility.

After nearly six months of operation, the CR is as functional as it is handsome, and the equipment has performed equally well. The fact that no modification has been necessary or desirable has proven the system layout and design, and system proof-of-performance was ideal.

Acknowledgement must be made to Mr. H. H. Schubarth, Director of Engineering for the Mullins Broadcasting stations, for his design of the system and his assistance. Mention must also be made to our two fine staff carpenters whose craftsmanship gave the installation its custom appearance.▲

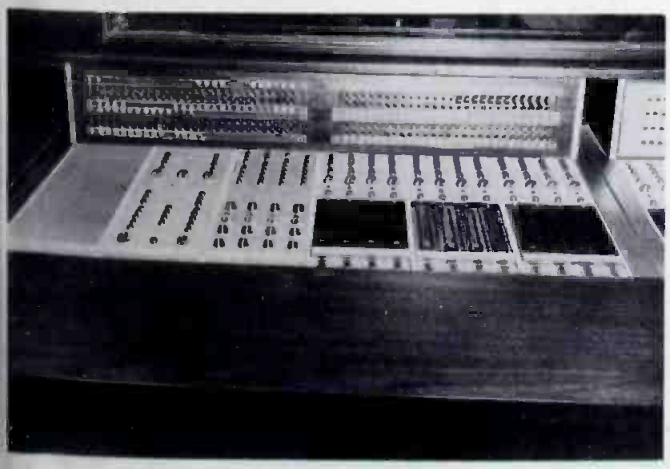


Fig. 8 The completed #1 console.

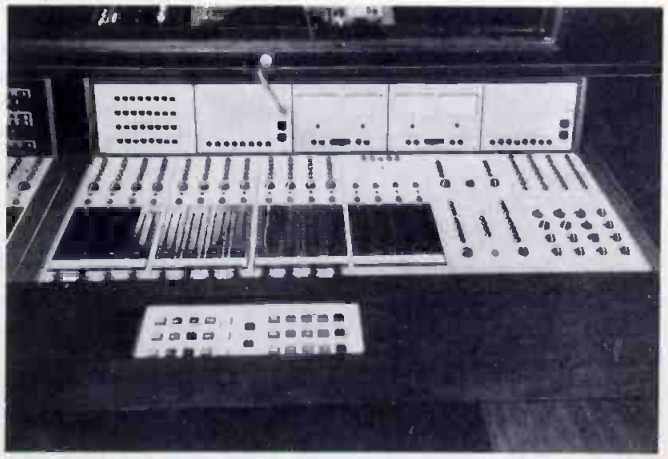


Fig. 9 The #2 console. The small panel in the foreground is a remote control for the reel-to-reel and cart machines.

Remember The Versatile Relay?

Don't abandon your old parts box. There are still circuits where those relays can be used.

By Fred Chapman*

In today's solid-state world, where everything seems to run on four D-cells, we tend to overlook the virtues of some of our old friends in the electronic parts field. Such is the case with the relay.

Most good relays costing five dollars or more are good for 100,000 to 1,000,000 operations. They have a fairly fast attack and release time (in milliseconds), and are capable of handling large currents while 'standing-off' good sized voltages. The advantages of solid-state switching are small size, high speed and (in theory) unlimited life. This last factor can be negated in the blink of an eye by one overvoltage spike.

In high speed data handling and processing systems, the solid state 'relayless' circuits are at home. For many slow speed operations, however, it makes no sense to trade a $5 relay with one or two associated components which will last three or four years, for a $40 PC board bristling with vulnerable, solid state parts. In many cases, a simple relay circuit can be made to perform logic functions which require a number of solid-state components.

The Classic Circuit

Let's take a look at Figure 1. In (a), we have the classic relay circuit. S1 may be a pushbutton or a snap switch. D is used to prevent high voltage spikes when the voltage is removed from the relay. (We assume our relay is surrounded by solid state devices which must be protected from such transients.) Note that, regardless of the wiper connection, the outputs are limited to on-off functions in step with the input switching.

In (b) we have replaced the diode with a resistor capacitor network. This is the 'delayed off' circuit which is usually shown with just a capacitor. Use of the resistor, however, keeps the supply voltage from being pulled down to almost nothing at the instant S1 is operated. Note that we may now obtain either a delayed off or a delayed on for the NC contact depending on the connection of the wiper. So far – no earth shaking circuits.

Now lets look at (c). Here we see a 'delayed-on, delayed-off' function. Looking at the two output waveforms, we show very different patterns with the two possible wiper connections. D is needed with the connection as shown to prevent the capacitor discharge 'burps' shown as shaded areas in the first waveform drawing. In (b) and (c) the 'off' delay is controlled by the size of C, the DC resistance of K's coil and the dropout voltage of K, which is usually about 10 percent of the design voltage (2.4 Volts for a 24 Volt relay). This drop out will vary with the number of poles, spring tautness, etc. The 'on' time of (b) is the normal one for the relay. In (c) the on time is controlled by the value of R and C. This is rather a complex circuit which must be carefully designed.

RxC must be large enough to give the proper 'on' delay without making R so large that the voltage is dropped across K to too low a value to allow pull-in. The running voltage of the circuit, determined by the DC resistance of K and the value of R in a voltage divider will also control the drop-out delay time. You will note the 'as-shown' circuit is capable of an interesting output waveform.

Multiple Function

In (d) we get a timed 'on', similar to the transistor 'one-shot' circuit. Current will flow through K's coil until C is fully charged, then stop. R is made large enough so that it will not provide 'hold-in' for the relay but not too large to allow bleed-off of the charge across C when the switch is off. D is needed when wired as shown to prevent a long discharge tail.

If you want to have some fun take the circuits of (c) and (d) Draw a DPDT relay and wire one

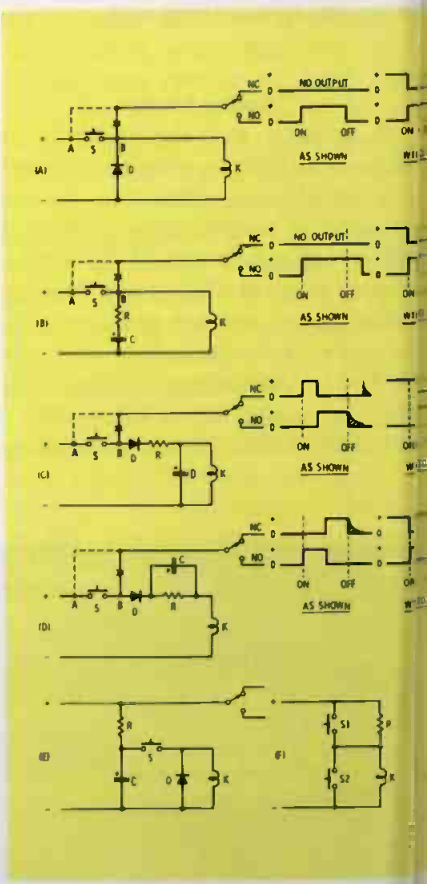


Fig. 1 At top (A) is a classic relay circu (B) the diode of (A) is replaced with resistor-capacitor network. The circ at (C) is a delayed-on, delayed-off desig (D) is a timed 'on' circuit. (E) and (F) a unique pushbutton control circuits.

*CE, WMCF, Stuart, Fla.

wiper as shown and the other to 'A'. Then plot the outputs. Now figure out how many transistors you would need to create that magnitude of output functions!

Figure 1(e) and (f) show a couple of unusual pushbutton control circuits I have stumbled across. In (e) C is charged slowly through R, then when S is pushed, discharges quickly through K. If R is large, K will drop out when C's voltage drops below the 'hold-in' value. If R is small enough, K will hold in at minimum voltage. This circuit may be used where it is desired to operate a high current drain relay from a supply too small to operate it. For example, assume K to be a 700 Ohm, 28 Volt relay. Normal drain is 40 ma. Drop out current is about 5-8 ma. for most of these relays. Make R 2.7K. The maximum charge current for C will then be limited to 10 ma. Running current will be 8.2 ma. R may be raised to as high a value as desired (determined by the allowable charge time for C) if K is to drop out after C discharges.

In (f), full relay current is drawn while S1 is pushed, but only the hold-in current while the relay is operative. S2 shorts the relay and causes it to drop out. In practice it is best to limit the running current to no-less than 25 percent of the known full-voltage coil current. This will insure solid operation of the contacts.

Figure 2 shows a circuit which was developed to perform a group of design functions. (This is a for-real circuit.) Let's look at its operation. If S1 is pushed with K1's contacts as shown, it will operate K3. When K3 pulls in, charged capacitor C3 will discharge through K4, causing the stepper to advance. When S1 is released, C2, which was charging while K3 was pulled in, will discharge through the step switch wiper W1, operating external circuits 1-2-3—n, whichever is selected by the stepper. Now, if we depress S2 for a moment before pushing S1, we will close and latch K1. This changes S1's output to feed to the two diodes D1-D2. Now when S1 is pressed, K2 is pulled in and K1 is held in (even though its 'hold-in' contact W2 has been disconnected by W2-K2). When S1 is released, K2 will hold-in a bit longer, allowing K1 to drop out. Then K2 drops out. The next operation of S1 will now be shifted to K3.

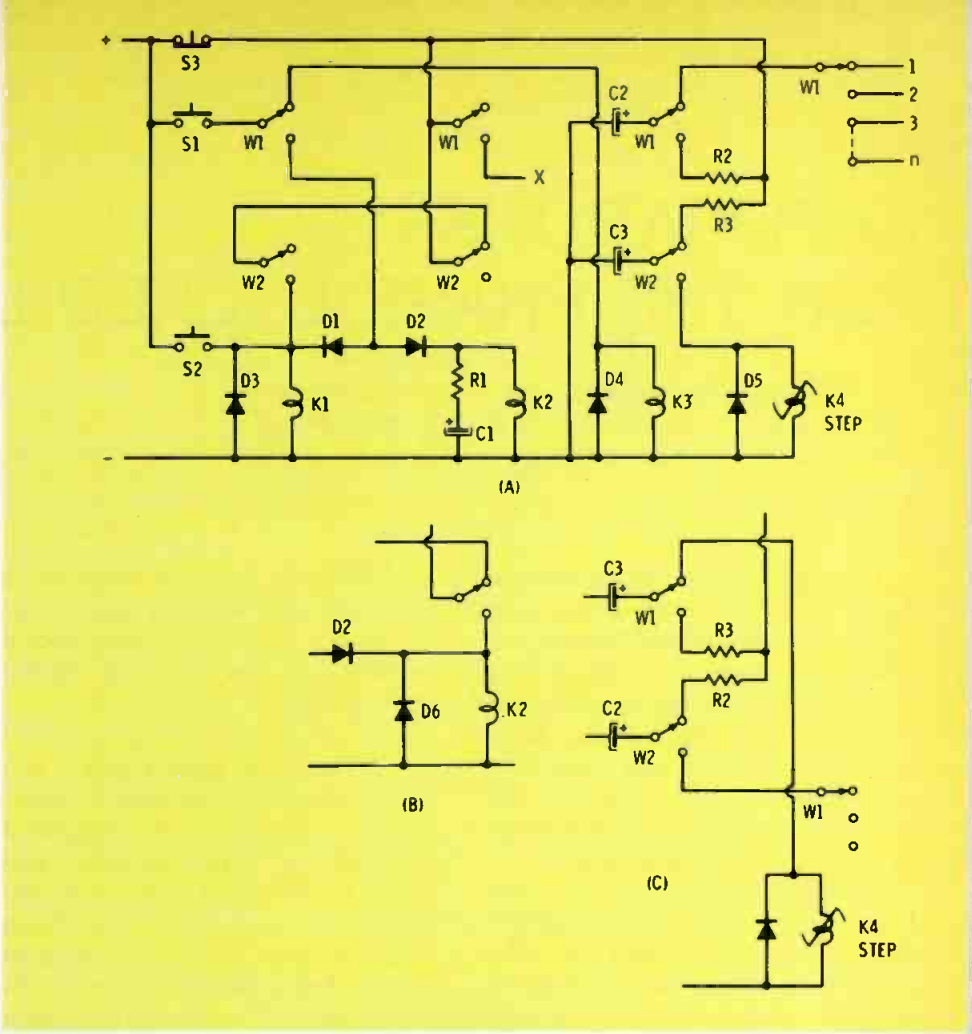


Fig. 2 Circuit designed for a group of functions. Is used in the WMCF automation system.

Some modifications are possible. K2 may be made to latch closed, in which case it will drop-out only when S3 is pushed. The arrangement of the capacitors, etc., of K3 can be changed to cause an operating pulse to be fed through the wiper of the stepper when S1 is pushed. The stepper then advances when S1 is released and K3 drops out. This circuit is actually in use in an automation system design. You will note that where there is no capacitor or resistor path shunting the relay coils, they are shunted by diodes. This, as stated before, is to protect the system from voltage spikes which could ruin solid state components.

No Panacea

By no means have we attempted to cover in this short article all of the ways in which relays may be used. However, I hope that some of the ideas shown here will help to suggest to engineer's brought up on a solid-state diet some ways in which the older electronic devices may still be of great value in new design. There is a saying which I have heard; 'Don't use a transistor where a relay will do as well and don't use a relay if you can use a switch.' I don't subscribe wholeheartedly to this theory, but having spent about four years in high-level semiconductor research, I can assure you that the solid-state device is not always the answer to every problem. ▲

APPLICATIONS FOR THE PHASE LOCKED LOOP

The PPL has many applications in communications circuits. Here is an inside look at their operation and uses. **By Jack Mattis/Signetics**

The concept of the Phase Locked Loop (PLL) is by no means new. The first description of Phase Lock appears to have occurred in 1932 in a paper describing synchronous reception of radio signals. Since that time, the PLL has been used in a variety of applications, but has not achieved the widespread usage that might at first be expected.

General usage of the PLL has been hampered by the fact that the circuit complexity, and the relatively large number of components required, made its use economically unfeasible in many applications. In discrete component form, the PLL was simply too expensive for all but the most sophisticated applications which could justify the additional expense.

The recent development of the Phase Locked Loop as an integrated circuit, however, is doing much to change the picture, since the cost of an integrated circuit is only indirectly related to the number of components it contains. The monolithic PLL is now available as an inexpensive building block similar to the monolithic operational amplifier in the diversity of its applications.

The Phase Locked Loop

The phase locked loop is basically no more than a specialized feedback or servo system. The primary difference over conventional systems is that the feedback or error signal, rather than being in the form of a voltage or current, is a frequency. The equations which define the operation, and hence determine the characteristics, of the Phase Locked Loop however, are the same as would be found in conventional feedback systems.

The basic PLL, shown in Figure 1, consists of four building blocks: a phase comparator, a low pass filter, an amplifier, and a voltage controlled oscillator (or VCO). The heart of the loop is the phase comparator which compares the input and VCO signals and generates an output which is dependent upon their relative phase. This output signal, when filtered and amplified becomes the control signal which, when the loop is in lock, keeps the VCO frequency identical to that of the input signal. Should the input signal increase or decrease in frequency, the relative phase change with the VCO signal generates the control signal necessary to increase or decrease the VCO frequency accordingly.

The operation of the phase comparator may be shown graphically by Figure 2. When the frequency of the input signal is the same as the VCO free running frequency loop locks with a constant 90° phase difference between the two signals. With this phase relation the average DC value of the compared signals (which is to become the VCO control voltage) is zero since the positive and negative excursions are of equal area. This is expected because the VCO is already running at the proper frequency and hence needs very little control voltage to lock to the input signal. For input signals of higher or lower frequencies, the phase difference can shift up to 90° in either direction to generate waveforms with the positive or negative average DC values shown in Figure 2. The frequency deviation of the VCO, in response to the maximum positive and negative error voltages generated by the phase comparator determines the "tracking or "lock range" of the PLL. The Tracking or Lock Range can be further defined as: the frequency range, centered about the VCO initial free running frequency, over which the loop can track the input signal once lock has been achieved

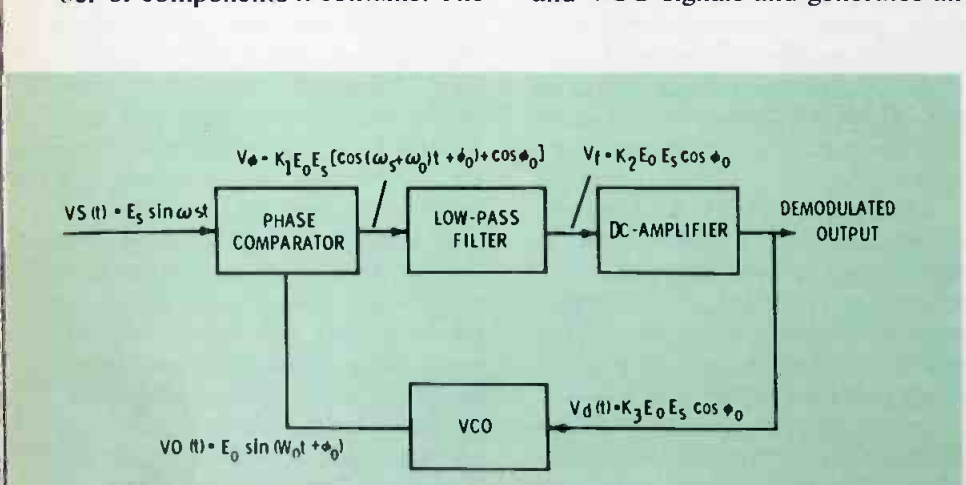


Fig. 1 Block diagram of a phase locked loop.

Another means of describing the operation of the PLL is to observe that the phase comparator is, in actuality, a multiplier circuit which mixes the input signal with the VCO signal. This produces the sum and difference frequencies $f_s \pm f_o$ shown in Figure 1. When the loop is in lock, the VCO duplicates the input frequency so that the difference frequency component $(f_s - f_o)$ is zero and, hence, the output of the phase comparator contains a DC component. The low pass filter removes the sum frequency component $(f_s + f_o)$ but passes the DC component which is then amplified and fed back to the VCO. Notice that when the loop is in lock, the difference frequency component is always DC, so that the lock range is independent of the bandedge of the low pass filter.

Consider now the case where the loop is not yet in lock. The phase comparator again mixes the input and VCO signals to produce sum and difference frequency components. Now, however, the difference component may fall outside the bandedge of the low pass filter, and be removed along with the sum frequency component. If this is the case, no information is transmitted, and the VCO remains at its initial free running frequency. As the input frequency approaches that of the VCO, the frequency of the difference component decreases and approaches the bandedge of the low pass filter. Now some of the difference component is passed which tends to drive the VCO towards the frequency of the input signal. This in turn decreases the frequency of the difference component and allows more information to be transmitted through the low pass filter to the VCO. This is essentially a positive feedback mechanism which causes the VCO to "snap" into lock with the input signal. With this mechanism in mind, the term "capture range" can be defined as: the frequency range, centered about the VCO initial free running frequency, over which the loop can acquire lock with the input signal. The capture

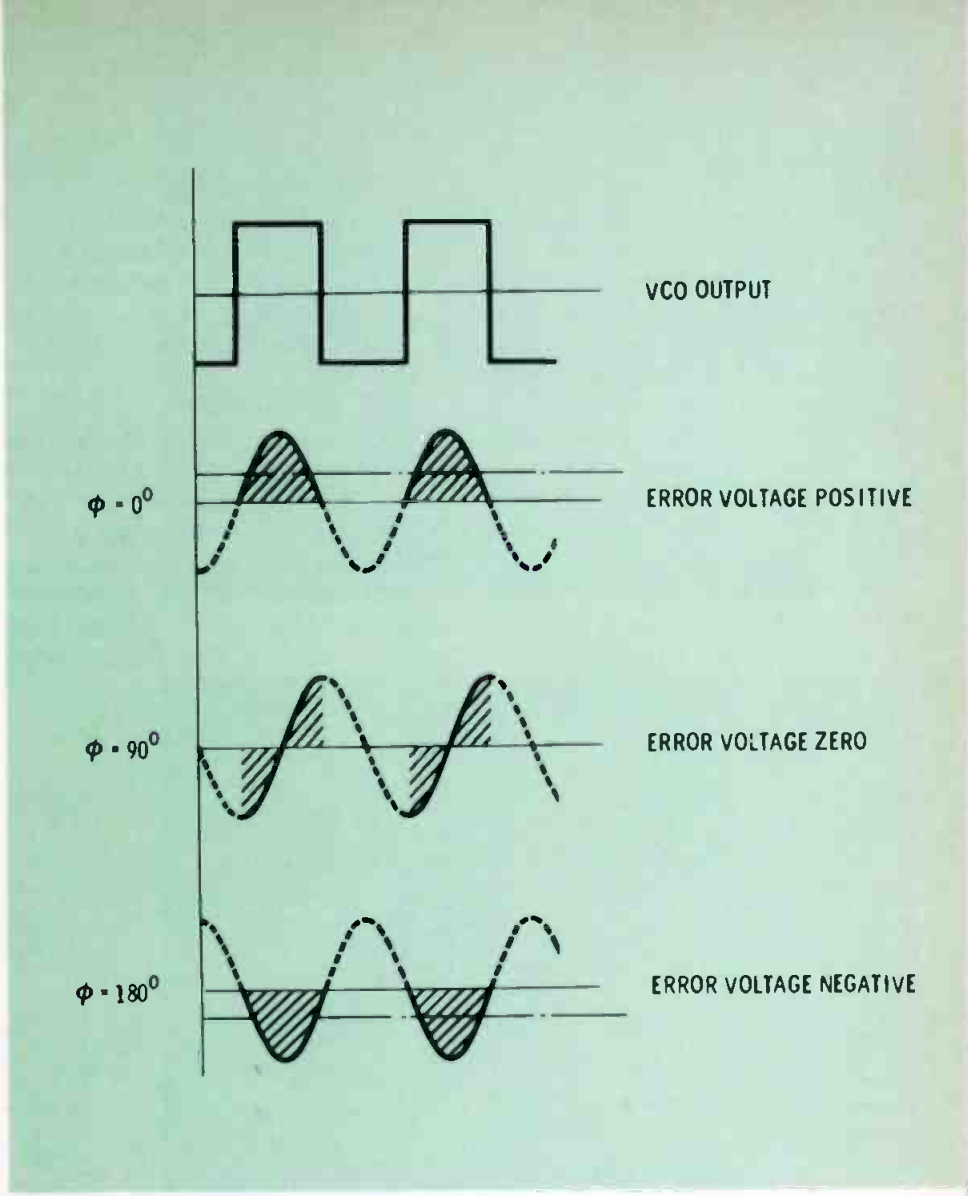


Fig. 2 Basic phase comparator output waveforms.

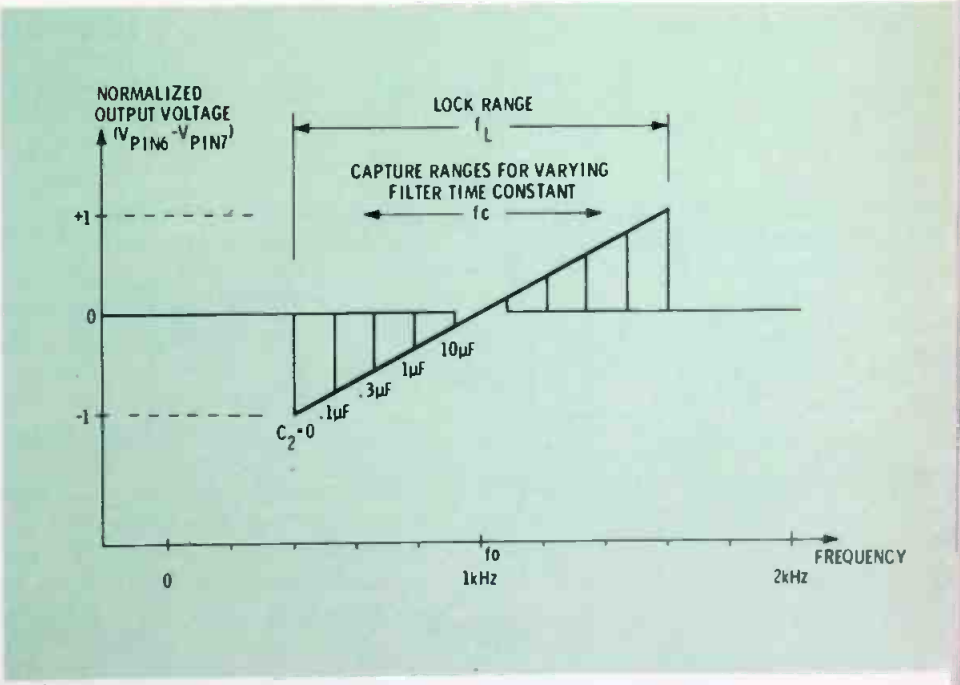


Fig. 3 Typical lock and capture range characteristics (SE/NE 565).

range is a measure of how close in frequency the input signal must be to that of the VCO to acquire lock. The "capture range" can assume any value within the lock range and depends primarily upon the band-edge of the low pass filter together with the closed loop gain of the system. It is this signal capturing phenomena which gives the loop its frequency selective properties. Figure 3 shows a typical lock and capture range characteristic for a PLL. Note that the capture range may assume any value within the limits of the lock range.

Applications

As a functional building block, the Phase Locked loop is suitable for a wide variety of frequency-related applications. Most of these applications, however generally fall into one or more of the following categories:

1. **FM demodulation**
2. **Frequency multiplication/ division/fractionalization**
3. **Frequency synchronization**
4. **Signal conditioning**
5. **AM demodulation**

FM demodulation is a fairly obvious application, since when the loop is in lock, the VCO frequency is identical to that of the input signal and the error voltage (which drives the VCO) becomes a direct representation of the input frequency. This error voltage then corresponds to the demodulated FM signal, and its linearity depends only on the control voltage to frequency transfer characteristics of the VCO.

FM demodulation applications are numerous, however, some of the more popular are:

1. Broadcast FM detection. Here, the PLL can be used as a complete IF strip, limiter, and FM detector which may be used for detecting either wide or narrow band FM signals with greater linearity than can be obtained with other means. It should also be noted that for frequencies within the range of the VCO, the PLL functions as a self-contained receiver since it combines the functions of frequency-selectivity

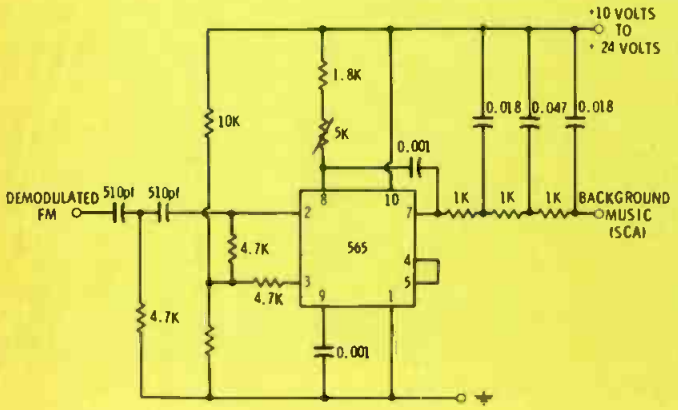


Fig. 4 SCA Demodulation.

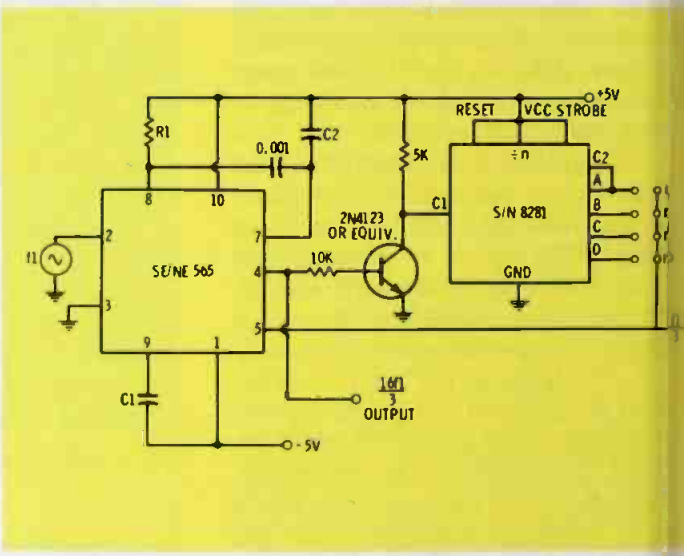


Fig. 6 Frequency multiplication with the SE/NE 565.

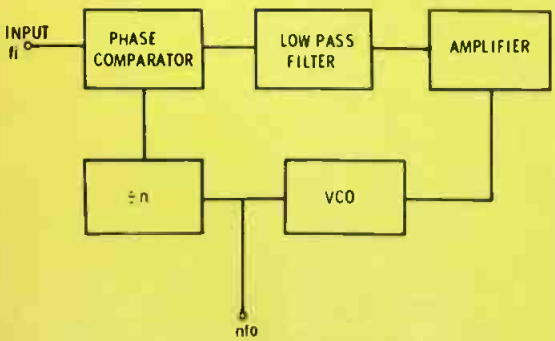


Fig. 5 Block diagram for frequency multiplication.

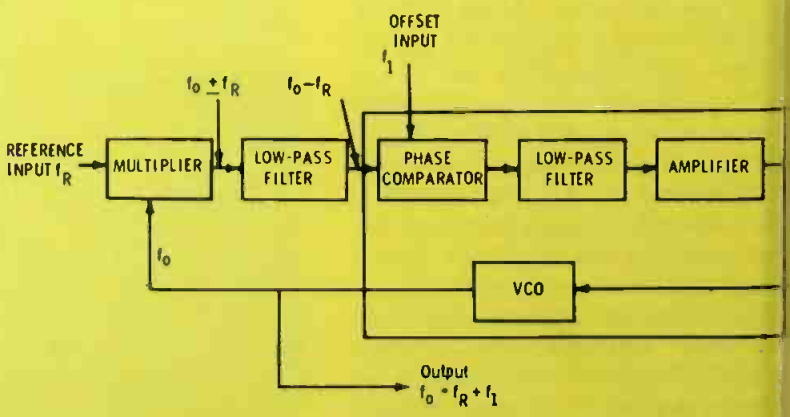


Fig. 7 Frequency translation.

and demodulation. One increasingly popular use of the PLL is in scanning-receivers where a number of broadcast channels may be sequentially monitored by simply varying the VCO free running frequency.

2. FM Telemetry

This application involves demodulation of a frequency modulated subcarrier of the main channel. A popular example here is the use of the PLL to recover the SCA (storecast music) signal from the combined signal of many commercial FM broadcast stations. The SCA signal, typically, is a 67 KHz, frequency-modulated subcarrier which puts it above the frequency spectrum of the normal stereo or monaural FM program material. By connecting the circuit of Figure 4 to a point between the FM discriminator and the de-emphasis filter of a commercial band (home) FM receiver and tuning the receiver to a station which broadcasts an SCA signal, one can obtain "hours" of commercial free background music.

3. Frequency Shift Keying (FSK)

This refers to what is essentially digital frequency modulation. FSK is a means for transmitting digital information by a carrier which is shifted between two discrete frequencies. In this case, the two discrete frequencies correspond to a digital "one" and a digital "zero" respectively. When the PLL is locked to a FSK signal, the demodulated output (error voltage) shifts between two discrete voltage levels, corresponding to the demodulated binary output. FSK, as a means of transmitting data, is used primarily over telephone lines.

Frequency multiplication can be achieved with the PLL in two ways:

1. **Locking to a harmonic of the input signal.**
2. **Insertion of a counter (digital frequency divider) in the loop.**

Harmonic locking is the simplest, and can usually be achieved by setting the free running frequency to a multiple of the input frequency and allowing the PLL to lock. A limitation on this scheme, however, is that the lock range decreases as successively higher and weaker harmonics are used for locking. This limits the practical harmonic locking range to multiples of approximately less than ten. For larger multiples, the second scheme is more desirable.

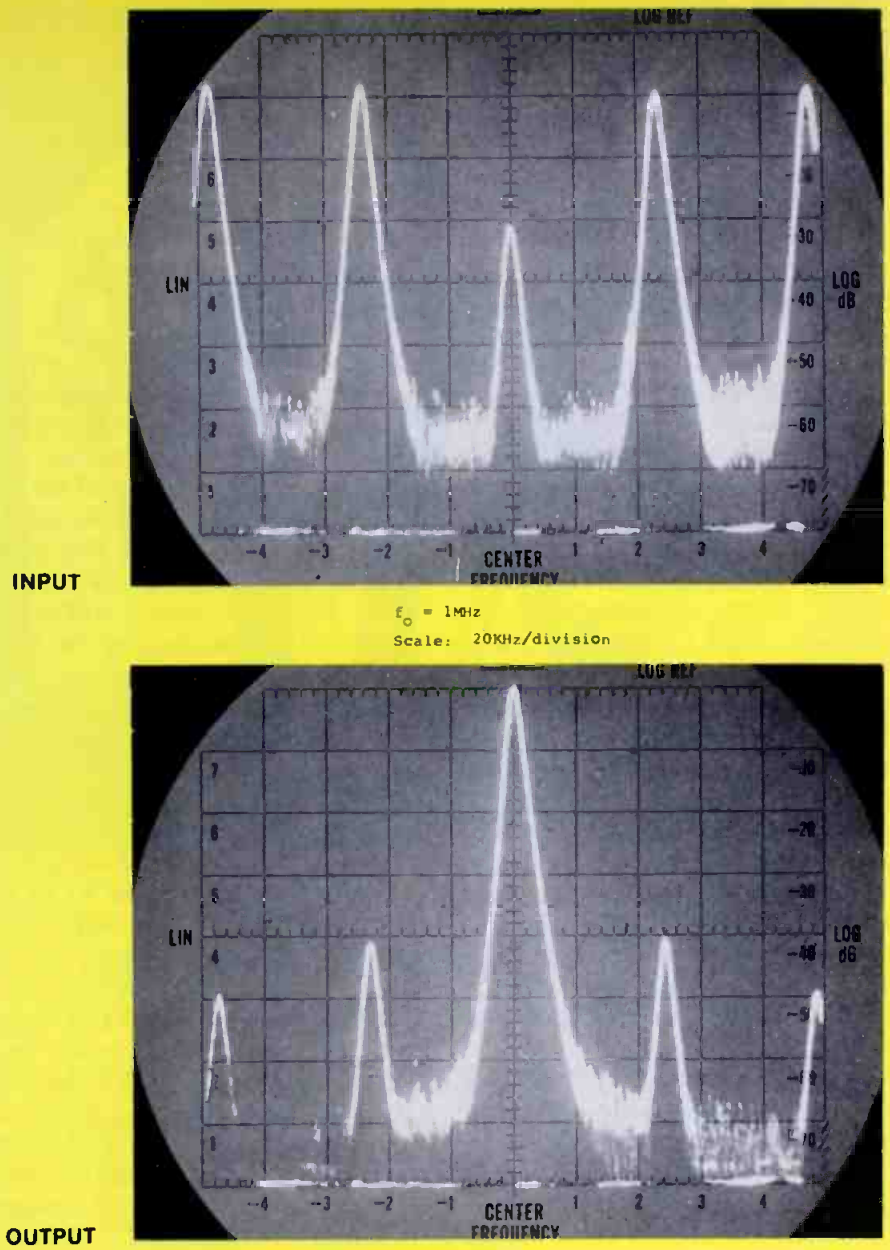


Fig. 8 Note reduction in sideband amplitudes when the VCO is locked to the fundamental. Makes PPL useful in digging out weak signals buried in noise.

A block diagram of this scheme is shown in Figure 5. Here the loop is broken between the VCO and the phase comparator, and a counter inserted. The fundamental of the **divided** VCO frequency is locked to the input frequency in this case, so that the VCO is actually running at a multiple of the input frequency. The amount of multiplication is determined by the counter. An obvious practical application of this multiplication property, is the use of the PLL in frequency synthesizers.

For the case of frequency fractionalization, both schemes could be used to generate, for instance, a frequency exactly 16/3 the input. In this case, the circuit of Figure 6 could be used with the initial VCO frequency set to approximately 16/3 the expected input frequency. The counter then divides the VCO frequency by 16, and the input is locked to the 3rd harmonic of the counter output. The output can

now be taken as the VCO output and will be exactly 16/3 of the input frequency so long as the loop is in lock. Frequency translation may be achieved by the addition of a second mixer (phase comparator) and low pass filter to the basic PLL as shown in Figure 7. This scheme allows small variations in the VCO output frequency even though its center frequency is locked to a highly stable reference frequency.

Frequency synchronization allows a relatively unstable VCO to be locked to a low level but highly stable input signal. The VCO output signal will now have the same stability as the input signal, but at a much higher power level. A popular practical application of this principle is to lock a PLL on to WWVB and generate a cheap laboratory frequency standard. Other practical applications include synchronizing disc or tape drive mechanisms in information storage and retrieval systems, slaving two system clocks together, or locking to a low duty cycle burst at a specific frequency in which case the PLL can regenerate a coherent CW reference frequency by locking on to the bursts. In addition, this principle might be applied to synchronize tape recorder speed for playback of a tape that had been recorded at an irregular speed.

Signal conditioning is generally used to remove unwanted sidebands from a signal, even though the sidebands may be so close to the fundamental that the usual filtering techniques prove ineffective. By proper choice of the VCO free running frequency, the PLL can be made to lock to any one of a number of signals present on the input. Thus the VCO is able to reproduce the desired frequency while rejecting the unwanted sidebands. Figure 8 shows the reduction in sideband amplitudes when the VCO is locked to the fundamental. This effective sideband reduction makes the PLL extremely useful in regeneration of weak signals buried in noise.

AM demodulation may be achieved with PLL by the scheme shown in Figure 9. In this mode of operation, the PLL functions as a synchronous AM detector. The PLL locks on the carrier of the AM signal so that the VCO output has the same frequency as that of the carrier but no amplitude modulation. The demodulated AM is then obtained by multiplying the VCO signal with the modulated input signal, and filtering the output to remove all but the difference frequency component. It may be recalled from the initial discussion that when the frequency of the input signal is identical to the free-running frequency of the VCO, the loop goes into lock with these signals 90° out of phase. If the input is now shifted 90° so that it is in phase with the VCO signal, and the two signals mixed in a second phase comparator, the average DC value (difference frequency component) of the phase comparator output will be directly proportional to the amplitude of the input signal.

The PLL still exhibits the same capture range phenomena discussed earlier, so that the loop has an inherent high degree of selectivity, centered about the free running VCO frequency. Because this method is essentially a coherent detection technique which involves averaging of the two compared signals, it offers a higher degree of noise immunity than can be obtained with conventional peak-detector-type AM demodulators.

One very practical application of this principle, is its use in tone decoding or frequency sensing applications. A specific example is the SE/NE567 Tone Decoder which, using this technique, is able to sense the amplitude of a specific frequency in a signal even though the signal itself may be buried in noise. Specifically, this circuit can sense the frequency and amplitude of the desired signal from an environment with a signal to noise ratio of up to −10 dB, without tuned circuits!

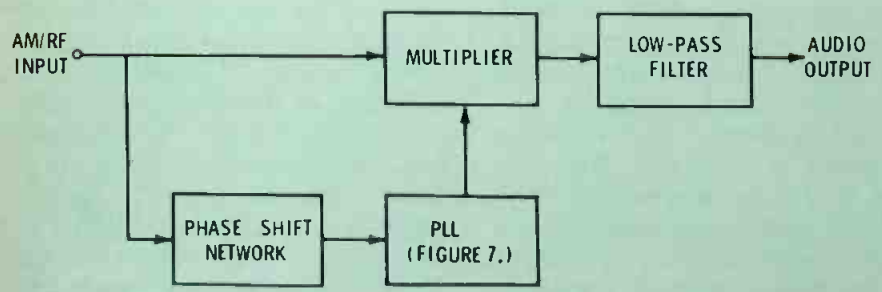


Fig. 9 Block diagram for AM demodulation.

Conclusion

These are but a few of the most fundamental applications of the phase locked loop. From these basic uses, technically speaking, come an almost limitless number of other possible applications. The fact remains, however, that it is the economic advantages of monolithic integration that makes most of these applications practical. Because the monolithic PLL is cost competitive with other existing techniques, and can, in many cases, give superior performance, it is destined to become a major building block of many new communication systems. ▲

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Old unit provides new answers for broadcast remotes

By Sidney King*

For some three years, KVOC and the Monarch Network were involved in pioneering the direct dial method of originating out-of-station broadcasts. These were particularly effective for long distance program origination in view of considerable increases in rates for broadcast loops.

During our early experimental period we experienced, and advised accordingly, problems concerning the elimination of certain frequencies which would disconnect a direct dial call. We also helped in the refining of equipment now recommended by the telephone company for direct dial origination. It generally consisted of a dial telephone with a recorder coupler attached. A station producing the remote broadcast merely fed its signal from its own mixing apparatus into the recorder coupler.

*Gen. Mgr. KVOC, Casper, Wyo.

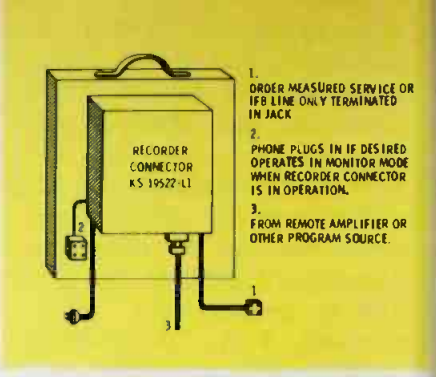


Fig. 2 Recorder connector connections for use at the remote site.

Although it was possible to g directly into the phone, many sta tions used this system. However there has been one serious problem This problem was experienced i for any reason there was a discon nect, inasmuch as it was almost im possible to reestablish connectio without finding an alternate mean of notifying the feeding broad caster so that he could hang up th telephone. This proved a source o embarrassment to more than a fe broadcasters as well as to th phone company.

During the past summer our sta tion engineers, along with some ex ceedingly cooperative employee of the Bell Telephone Company experimented with several dif ferent pieces of equipment. W found an answer to the problem o a disconnect which we would lik to share with you.

New Answer In Old Device

Strangely enough, the answe did not come from any newly de veloped equipment. We found i in a recorder connector whic has been part of the Bell Telephon system equipment for many years (The recorder connector is com pletely different in its operatio from the recorder coupler.)

The recorder connector (Lis #1-USOC Code RDC) is a com pletely self-contained unit whic the station originating a broadca can feed directly from a remot amplifier. The recorder connecto is wired by the standard telephon jack to a phone line. The statio originates the call by dialing a pre assigned number, and on the firs ring is automatically connecte with the recorder connector, there by receiving whatever signal

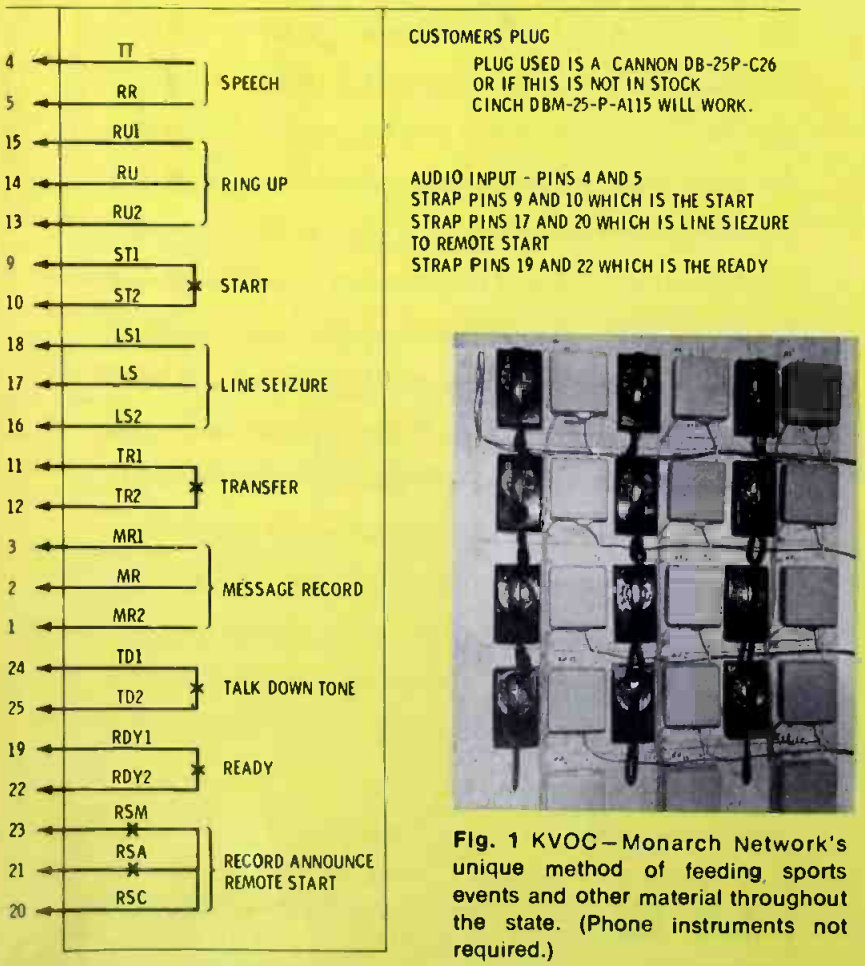


Fig. 1 KVOC—Monarch Network's unique method of feeding sports events and other material throughout the state. (Phone instruments not required.)

being fed into that instrument at the point of origin.

Please note that while a telephone is normally attached to the recorder connector unit, it is wired so that the telephone transmitter will not function during the period that the recorder connector is active. Actually, a broadcast may be originated and completed without the use of a telephone at the originating end, using only the recorder connector.

KVOC and Monarch Network have mounted both phone and recorder connector on a small portable board before traveling to do a sports broadcast. We merely request the telephone company to install a four prong standard female telephone jack and predetermine the telephone number assignment at the point of origination. Upon arrival, the recorder connector, using a male phone jack, is plugged in. The recorder connector also requires an AC source. We have established by using this method, that when a disconnect does occur, it is only a matter of some 15 seconds to have the station re-dial the number and be reconnected to the broadcast source.

Monarch Network not only originates its sporting events in this manner, but feeds some 15 other radio stations by having them dial into individual recorder connectors, each using a different telephone number assignment. Here again, the savings over the regular Class E or F broadcast loop is substantial and we have determined that there is less difficulty in feeding each station separately than we experienced when a broadcast loop broke down, requiring some length of time to locate and repair the trouble. ▲

ENGINEER'S EXCHANGE

Relay Controlled Mic

Many engineers have often thought that switching the control room mic with a relay would create problems. However, at WRSC and WQWK FM, we found that it works quite well.

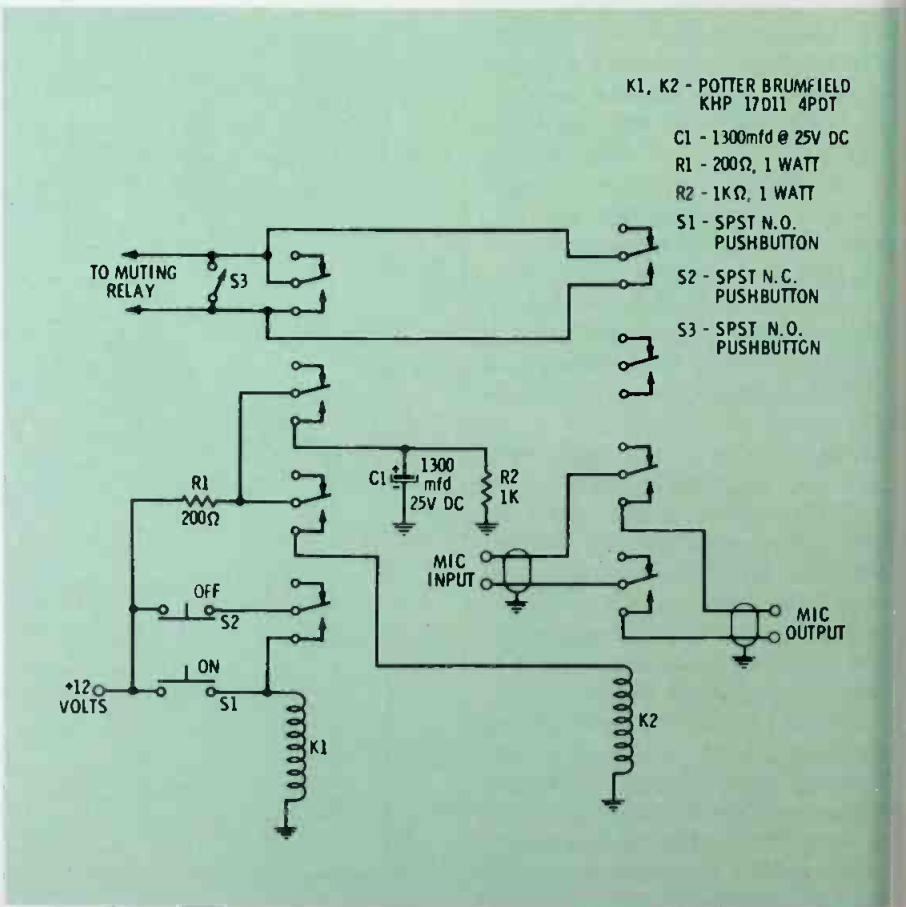
I believe that many engineers will agree that you could wire a control room to be operated many different ways...and still find that there are some announcers who will have their own set procedure for operating from the board.

Microphone switching in the control room was one of our problems for awhile. Some announcers would begin their show by setting a level on the pot and using the key without moving the level. This can be good or bad depending on the type of format programmed, or depending on the type of program aired by the individual announcer.

There have been engineers who have used cure pots for a mic in-put, using the cue switch for an on/off position. This also can be good or bad, depending on the format. However, this does not solve the problem of what to do for the announcer who does not like to do his show with this type of mic switching.

These are just a few reasons why we developed a relay switching microphone. With this unit, you may mount the on/off switches wherever they would be most convenient, because the switches only switch 12 Volts at less than 1 Amp. This gives you a wide selection of switches to choose from.

Figure 1 shows the wiring diagram of a typical relay switching microphone. (This one is used at WRSC and WQWK FM. The unit utilizes two relays, Potter and



Brumfield-KHP-17D11-12 Volts (DPDT.) One is for muting, the other for microphone switching.

In order to prevent feedback, a time delay constant is needed. There must be a delay between the muting relay and the mic relay. The delay between the muting relay and the mic switching relay may be controlled by the value of C1. This capacitor must charge before the mic switching relay will close. In order to keep the time constant the same each time the relay closes, a bleeder resistor (R2) must be added to discharge the voltage across the capacitor once the relay returns to normal (or off) position. This allows you to switch the mic on and off at any desired time, and still have the same time delay.

For the announcer who does not like to work with this type of mic switching, there is a defeat switch (S3) incorporated in the unit which will defeat the unit. This allows him to operate the board for normal mic switching.

The unit has solved many problems for WRSC and WQWK with on-the-air work.

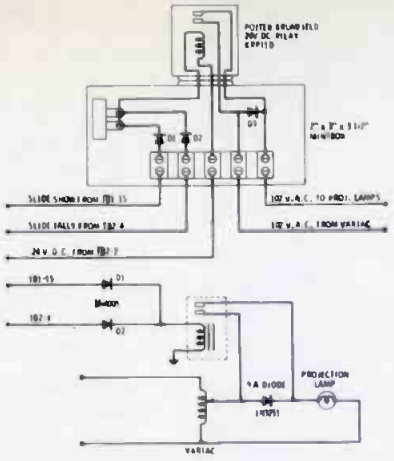
John Sweigart, Jr.
Chief Engineer
WKBO Radio
Harrisburg, Pa.

Lamp Idling System For Projector

Frequent replacement of TP-7 projection lamps dictated an investigation. The lamps are expensive and on-the-air flame out occasionally caused commercial loss.

KOMO-TV uses Eastman Multiplexers and RCA Projectors, consequently, the drawing shows connections for this configuration. This lamp idling system will work equally well with any multiplexer.

The Eastman PF11 has local pneumatic mirror changing buttons necessitation an OR gate of 1N4005 diodes. This allows the mirror limit



switch to fire the relay shorting the 1N3211 diode, or the remote mirror change switch can cause this function to occur.

The projector lamp idles at one half the RMS voltage, then as the mirrors shift for airing the slide projector, the lamp voltage rapidly rises to optimum.

During on-the-air changes, this rise is so fast as to be virtually undetectable in the video. The small mini-box is mounted out of sight

(Continued on page 45)

Send Your Exchange Ideas to Broadcast Engineering Yes—We Pay

Integrated Circuit Replacement

By Pat Finnegan

Integrated circuits may prove more reliable tha conventional devices, but they still fail, occasionally The problem seems simple enough: pull it out. Bu many IC's are soldered directly to the printed circu board. If you're lucky, they are plug-in types. Replace ment seems easy enough, but care must be taken, an the proper tools must be used.

In the days of vacuum tube circuits, regular siz tools were needed. However, the smaller (or even mir iature) tools should be used when working with soli state circuits. In addition, you should use a small size 25-40 Watt iron. (One with a variable heat control i helpful.) The tip should be about 1/16th of an inch wide

A device for removing solder is a "must". There ar several types available. The piston type device work well. It is cocked so that when the trigger is release it will vacuum off the melted solder. Another hand model is heated like a soldering iron, but it has chambe and a squeeze bulb to vacuum off the solder. (If yo haven't bought one yet, you can "wick-up" the solde by holding a braided wire on the melted solder.)

Of course, a bench vise is an asset. You probabl will need both hands in solder removing operation

Whether or not the IC must be replaced should b determined by dynamic signal tracing methods ar followed by voltage checks. Ordinarily, if a signal goe into an IC but doesn't come out properly—yet inp voltages are correct—the IC is defective and must b replaced. There just is no way to repair an IC . . . it got to come out.

Before you attempt to remove the IC, its positio on the board should be noted. Locate pin #1. The may be a #1 engraved or printed on the board. If no mark it yourself. Once the IC is out, you may fin your time wasted trying to figure out the prop orientation for the new IC. If you install it reverse the circuit will not work, and worse yet, you may ru the new IC.

IC Removal

Heat the solder and remove it from all pins. Ev with the solder gone, the tinning may still keep th pins stuck. With a small size long nose pliers, gent press each pin sideways (toward the board) and ea will break loose. Remove the IC and then check t board to make certain the new IC will fit easily on the board. Clean all connectors.

When soldering in the new IC (or any solid sta device) a good safety measure is to lightly spray t device with a shot of coolant. Then if there is a trouble soldering any or all pins, the excessive he will not damage the device. Remember also, that t printed wiring on many boards will not hold to t board after excessive heat has been applied.

Add the new IC in correct orientation and solde to the board. Make certain no solder gets between t pins and shorts them out. There isn't much roo Then inspect the solder job, but be kind to yo eyes—use a magnifying glass.

(Continued from page 43)

in the multiplexer cabinet.

Reliability is excellent as our two units have operated continuously for four years without requiring service.

Lamp life increased markedly, making the small cost of the units well worthwhile.

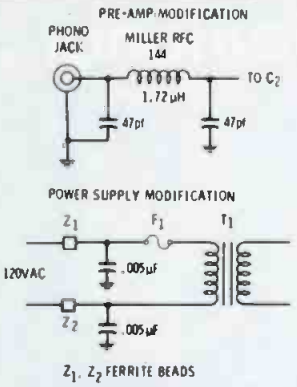
F. J. Fowler
Project Supervisor
KOMO-TV
Seattle, Wash.

RF Proofing TT Preamps

Since I have not seen much on RF proofing of broadcast equipment in **Broadcast Engineering,** I am sending information on RF proofing the Gates M6244 and 6244B TT preamps.

Beginning with the advent of FM and more so of late as more FM licenses are granted, engineers are having to cope with the problem of RF feeding back into their control room, studio and production room equipment. In many cases the FM station is an add-on event at the AM studio location with the FM tower located immediately behind or to the side of the AM studio. Normally the building is not shielded. With a circular polarized antenna above the building, the equipment is subjected to a high RF field.

We encountered RF problems in all our equipment, including the Gates turntable preamps, and we found that by doing the following we could almost completely eliminate it. We use M44-7 Shure cartridges and Gray 208S and 303 micro-trak arms.



To RF proof the Gates Preamp;

we removed the scratch filter switch—we planned not to use a scratch filter or play scratchy records. Then we removed TB-1, including scratch filter condenser and ground straps.

Cut out a small metal panel to overlap the hole left by removal of TB-1, you may start re-wiring. Use a Miller RFC 144 RF choke and wire from center pin on phono jack to C2 of preamp. Bypass center pin of jack to ground using a 47 pf capacitor. Also run amplifier ground to ground side of phono jack. Be sure to make all leads as short as possible. Now, if you have any ferrite beads, install them on AC leads to power transformer and bypass both sides of AC line to ground with .005 mfd capacitors. All capacitors should be ceramic for small physical size and short leads. If ferrite beads are not available, just bypass AC leads.

R. T. Whitaker, CE
KINE-KPUP
Kingsville, Tex.

NEW PRODUCTS

(Use circle number on reader service card for further information)

New Zoom Lens

Angenieux Corporation of America has a new zoom lens with basic focal length capability of 18 270mm, and a total focal length range of 18-675mm using the range extender turret. The complete 15x18E is an entirely new concept in studio lenses, and a new standard since the introduction of the first 10:1. This lens is also designed for remote applications not requiring extremely long focal lengths.

For studio operations and remote broadcasts, the short focal length of 18mm (51° horizontal angle) has been retained and the longer focal length has been increased from 180mm to 270mm. The aperture of f/2 (f/2.4 for the lightweight "L" model) remains constant throughout for focal lengths between 18 and 180mm thereafter dropping linearly to f/ (f/3.4 for the lightweight "L" model for the standard 1¼" plumbicon.

The 15x18E has a close focusing distance of 25" (21.7" for the "L" model) and still retains its full zoom capability. With a close-up adapter and range extender the lens also capable of full-screening a object of less than one-half inch in height.

The positioning of the three range extenders (1.5x, 2x, 2.5x) an integral part of the lens: all are housed in a turret at the rear of the lens which can be remotely controlled. An entirely new development and an essential feature the 15:1, there are two important results: first, the need for a sliding carriage support system is eliminated thus reducing the weight second, the essential ease of controlling the range extenders from the rear of the camera by means a small electric motor activate

by a turret command box. Change in range extenders requires only about one second, and the iris is automatically set to compensate for variations in video level.

Circle Number 60 on Reader Reply Card

Dolbyized Recorder

The **Revox** A77 is now available with the Dolby B Noise Reduction Unit as an integral part of the recorder.

The unit is equipped with four additional Dolby-Processors, two compressors and two expanders, one for each of the two record and reproduce channels. Thus, the recorder can record and play on each channel individually or on both together, with or without the Dolby system being in effect.

The Revox A77 Dolby version has an additional on-off switch to bring the Dolby electronics into the circuit. Revox claims the built-in calibration controls and reference oscillator allow calibration of such a high degree of accuracy that the frequency response remains the same, regardless of whether the Dolby electronics are in or out of the circuit. The built-in multiplex filter protects the Dolby electronics from interferences.

Circle Number 61 on Reader Reply Card

Triggered Sweep Scope

Sencore, Inc., manufacturer of quality professional test equipment has announced a new, low cost, dual channel-dual trace oscilloscope featuring both triggered and free-running sweep.

The new scope, model PS163, is said to provide the features and stability of lab type scopes for a fraction of their cost. The company spokesman also stated that the operation of the scope has been greatly simplified with the use of pushbutton switching and employing both manual and automatic triggering.

The free-running sweep, an exclusive feature, allows the unit to be operated as a service type scope for those technicians unfamiliar with a triggered scope. The PS163 may be operated either single or dual trace and has been designed to fill the demand for a low cost lab type scope in both servicing and industrial applications.

(Continued on page 48)

New Products

(Continued from page 47)

The stable triggering circuit and time base calibrated to 2% accuracy allows precise time and frequency measurements necessary in many industrial and design applications. Special TV vertical and TV horizontal sweep positions with a sync separator stage have been added to permit stable displays of complex television signals. The dual trace, triggered operation is considered by the manufacturer to be a valuable asset to the television service technician when troubleshooting difficult AGC and chroma problems. The critical timing of concurrent waveforms present in these stages can be readily observed to check stage operation.

Circle Number 62 on Reader Reply Card

Supercard Kit

Television Equipment Associates introduces a new graphics kit for the immediate production of supercards and titles which will be marketed under the name MAGNETITLE.

Two sizes of flipcard boards with a mat-finished black steel facing and dimensions of 11"x14" and 16"x 20" are supplied with edge markings to facilitate horizontal and vertical positioning of words. Letters are screen-printed in white on black vulcanized fiberboard and are easily moved around on the flipcard board for best layout effect. Shadows are electronically eliminated. Four alphabet fonts are currently available with others to follow. The complete kit includes four boards, four fonts and a container.

Circle Number 63 on Reader Reply Card

Custom Turntable

The GT-12 custom turntable from **Sparta Electronic Corporation** has three moving parts set in a one-piece cast aluminum ribbed frame. The user has a choice of two motors, a hysteresis synchronous (GT-12-SY) or four-pole (GT-12-4P). Wow and flutter is held to 0.1% at 33⅓ RPM. Rumble is 45 dB at 33⅓ RPM and 40 dB at 45 RPM.

The GT-12 features a one-hand cueing lever. The power-paddle switch is spring loaded in one direction allowing the platter to turn until the switch is released. When the switch is activated in the other direction the platter will continue to rotate until the switch is manually returned to the neutral position.

Speeds of 33⅓ and 45 RPM are selected by a single front mounted lever. When the lever is centered the turntable is in neutral. The lever when moved to either the right or left, will activate the motor and select the speed.

Available to complete the SPARTA GT-12 system are M232 or M236 Tone Arms, and TEP-3S (stereo) or TEP-3M (mono) turntable pre-amplifiers. The tone arms have low tracking forces and provide for critical adjustments. The turntable pre-amplifiers are equalized for the RIAA standard curve and designed for both high-Z and low output cartridges.

Circle Number 64 on Reader Reply Card

Patch Cords For Miniature Jack Panels

For miniaturized telephone broadcast, telecommunications and industrial patching applications **Switchcraft, Inc.** has designed a new series of 2- and 3-conductor shielded patch cords.

Designed for Switchcraft, "tini-telephone" jack panels and equivalent, TT-840 (3-circuit) and TT-860 (5-circuit) Patch Cords can be specified in a variety of types and lengths from 6 inches to 6 feet for interconnecting applications requiring 3 and 5 circuit twin patch

Send Your Letters To The Editor To: 1014 Wyandotte Kansas City, Mo. 64105

cords.

The new patch cords feature bronze tinsel conductors covered with thermoplastic insulating material. Woven over insulated conductors is a braided shield and a black nylon braid.

The series use standard Switchcraft 2- and 4-conductor cords with a TT-Twin Plug phone plug attached at each end.

Circle Number 65 on Reader Reply Card

Stereo Amp/Receiver

One of the latest additions to the growing line of quality stereo receiver/amplifiers is the **Heath** AR-1500. The unit **BE** tested moved the state-of-the-art ahead once more.

Fig. 1

The AR-1500 should not be tackled by the inexperienced builder, but for the builder it answers a lot of questions. The AR-1500 takes a lot less time to build than the AR-15. But what has bothered many builders is that on homebrew circuits, they have tested each circuit as it was finished... reducing the meaning of a "smoke test." Heath has used this same approach. And they took it a step further.

As shown in Figure 2, the major unit circuits are built on circuit boards. These boards plug into hinged connectors, allowing a quick disconnect should trouble occur. With the covers removed, the unit can be relieved of most of its major circuitry in just a few minutes.

Troubleshooting represents no particular problem, because Heath has built-in circuitry that allows its panel meters to be switched for making relative resistance and voltage readings. Although each board is checked before it is inserted in the unit, it also is checked after installation. As a backup for any trouble that might occur, the manual contains circuit board operation details, numerous point by point check lists, voltage test points and photos. From a builder's

(Continued on page 50)

Two-Faced Production Timer/Stopwatch

Radio and TV production and engineering personnel can observe elapsed time simultaneously with the new ADRL Two-Faced Two-Timer marketed by T.E.A. Because of the two readouts, the unit has no back. Instead, it has two fronts.

The timer can be ordered with either a 3 or 4 nixi-tube display for maximum elapsed time of nine or 99 minutes 59 seconds. Single-faced models are also available, plus remote controls for Stop, Start and Reset. Controls can be interfaced with audio or video tape recorders and cart machines, and prices start at $225.00.

Circle Number 67 on Reader Reply Card

For More Information on Products advertised or described in this issue use Free Reader Service Card. Be Sure to include your name and address.

Circle Number 32 on Reader Reply Card

(Continued from page 49)

standpoint, the AR-1500 should be a challenge, even with all its assurances.

The time-saving, troubleshooting advances are equal to the circuitry involved. But here again, you notice that there is something different. Squelch circuits (controlled from the front panel) are seldom found, as are special built-in oscilloscope vertical and horizontal amplifier circuits. Once attached to the AR-1500, the scope will indicate FM multipath reception, tuning, and signal strength.

Field effect transistors in the preassembled FM tuning unit and AM RF circuit provide excellent sensitivity and large signal handling capability. L-C filters in the IF circuits increase selectivity and stereo separation and never require alignment.

The direct coupled power amplifiers will drive the most demanding speakers. Limiting circuits protect the power amplifier from damage during excessive power dissipation periods, including shorting the speaker terminals. Output sockets are provided for two separate speaker systems and are controlled by pushbuttons on the front panel. Cross-over outputs for use with electronic cross-over networks and external amplifiers are included.

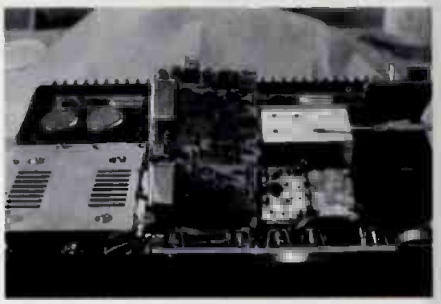


Fig. 2

System specs include: frequency response is ± 1 dB from 20 to 15,000 Hz; harmonic distortion .5% at 1000 Hz with 100% modulation; SCA suppression is 55 dB; and channel separation for stereo is 40 dB or greater at mid frequencies. For Mono: sensitivity is 1.8uV; selectivity 90 dB; image rejection 100 dB; IF rejection 100 dB. Dynamic power output per channel: 90 Watts (8 Ohm); 120 Watts (4 Ohm); 50 Watts (16 Ohm).

Circle Number 66 on Reader Reply Card

bookreview

Beginning with this issue of BE, we are using Reader Service card numbers with our book reviews. If you're interested in any book we cover and if you want more information, such as prices and paperback vs. hardback offerings, note the "circle number" at the end of the review. Tear out the Service Card, fill in all blanks, circle up the numbers of items that interest you, and drop the card in the mail.

The new Sams Technical Book Catalog lists dozens of new and revised titles designed to increase technical understanding and know-how in every phase of electronics and allied areas... including electronics math.

Each subject is presented in simple, easy-to-understand terms and made completely clear with show-how photos and drawings. Facts and methods are easy to grasp... and easy to remember. Here are the professional trade methods that put new skills and abilities in your hands.

Circle Number 75 on Reader Reply Card

The second edition of Howard Tremaine's **Audio Cyclopedia** is now available. Nowhere is there a book more important to broadcasters who work with audio than this one. Tremaine has updated his authoritative reference volume in most areas, so it should remain a "must" book for every station.

This volume of about 1,800 pages covers every phase of audio and includes the latest solid state and integrated circuit devices as they are used in audio.

After the first edition of this volume had been circulated, it became known in some circles as "the audio man's bible".

It's available by book number 20675 in the hardback version from the Howard W. Sams Company, 4300 West 62nd Street, Indianapolis, Ind. 46206.

Circle Number 76 on Reader Reply Card

The Technique of the Sound Studio by Alec Nisbett of the BBC) is another revised audio book, but this one takes another approach. The book is concerned with general principles and not with the operation of particular items of equipment. It deals with the medium in which, within certain limits, the final judgement must always be subjective. It places emphasis "ear training", telling what to listen for, and how to analyze the characteristics of good and bad sound effectively and quickly.

High interest chapters deal with microphone balance of music and speech, and characteristics of microphones and studios, together with other equipment used. Uses the most elaborate and most simple studios as examples.

Available through Communication Arts Books, Hastings House, Publishers, Inc. New York, N.Y. 10016.

Circle Number 77 on Reader Reply Card

TECHNICAL DATA

For further information, circle data identification number on reader service card.

100. AEL COMMUNICATIONS CORP.—A four-page brochure entitled "Tomorrow's Capabilities Now!" featuring the latest in CATV equipment is now available. The completely illustrated brochure gives full features and detail on AELCC's Super-Band Challenger Mark Series single and dual cable bi-directional trunk systems, trunk extender amplifiers and other special CATV units. Booklet stresses special features, money-saving characteristics and applicability. All units are fully diagramed, in color.

101. ALLIED RADIO SHACK—Allied Radio Shack's new 1972 Electronic Parts & Accessories Catalog lists thousands of hard-to-find electronic items, including those parts and pieces most often needed to keep equipment working, and the accessories used with them. The 132-page catalog is a complete buying guide for hobbyists, kit builders, hams, CBers, "fix-it" men, electricians, servicemen, technicians, hi-fi installers, experimenters and anyone interested in any aspect of electronics. Exclusive Allied, Realistic, Archer, Micronta and Radio Shack brand products are listed, as well as the complete line of Knight-Kit and Science Fair kits.

102. ALLIS-CHALMERS—Specifications on Allis-Chalmers Model DES-45 Diesel Electri System are presented in a new si page brochure, Bulletin EE-304 Rated at 45 kW continuous dut the DES-45 is designed for bo standby and prime power use. T DES-45 is suitable for lightin heating, motor circuits, commun cations, and similar application The brochure describes precisio performance features of the se Charts and graphs illustrate voltag and frequency regulation charac teristics, power ratings, and fu consumption using the standar Allis-Chalmers Model 2800 6-cy inder 73 hp diesel engine. Com plete physical data and discussion of standard components and o tional equipment are also include

103. ALTEC DIVISION—"O tario Motor Speedway Incorp rates the World's Most Powerf Sound System" is the title of a ne 16-page brochure available fro the Altec Division of LTV Lin Altec, Inc. The brochure detail the technical problems and th innovative answers provided f the 30,000 Watt system at OM the largest facility of its kind in th world, covering more than 70 acres of ground, and having sea ing capacity for 140,000 persons i the grandstands.

104. ANACONDA WIRE AN CABLE CO.—A new telecommun cations cable for T-1 Carrier sy tems is described in a four-pa bulletin. The cable features tw extra pairs, one for repeater inte rogation and one for voice ord wire, and two compartments f electrical separation of pair group All pair counts of the new cabl known as Plus 2™, are said to allo 100 percent of the pairs to be us for T-1 Carrier systems, with tran mission in both directions, at ma mum repeater spacing. Accordi to the bulletin, all repeater housi spaces can be utilized regardless whose equipment is installed. Cab pairs from the nominal pair cou need not be allocated for repeat

nterrogation and voice order wire functions. Maximum repeater spacng is possible due to improved ear-end crosstalk coupling loss haracteristics. Separation of the ore into two compartments by neans of a polyolefin-coated metalic shield enables simultaneous ransmission of T-1 line signals in pposite directions without intererence between channels.

105. ARCIDY ASSOCIATES—The new two-color, 20-page catalog from Arcidy Assoc. details the ompany's comprehensive capaility in wirewound resistors over he range of 10 milliwatts to 50 Watts. Covering nearly all the popular package configurations of both precision bobbin and power type esistors, the catalog also describes new combination precision-power levice geared to be competitive vith metal-film counterparts. Among the power styles described re both silicone coated and molded xial lead types, aluminum housed hassis-mount and through-mount ypes. Precision styles include tandard and miniature axial lead, adial lead, axial-radiallead, cylinrical and rectangular printed circuit, lug terminal, high frequency nd hermetically sealed packages.

106. B&K INSTRUMENTS, INC.—B&K's new 1971/72 Short Form Catalog describes briefly the firm's ull line of precision transducers nd instrumentation for sensing, neasuring, and analyzing all aspects of sound, noise, and vibraion. Included are accelerometers; rtificial ears, mastoids, and voice; udiometer calibrators; deviation ridges; digital and data processing quipment; filters; frequency reponse tracers; hearing aid test oxes; spectrum shapers; graphic evel recorders; measurement mirophones; noise generators; noise nonitoring equipment; oscillators; ower amplifiers; sound level meers; real-time analyzers; signal onditioners; tape recorder; vibraon control equipment; and voltneters. This catalog is a handy eference for those involved in pplied acoustics, mechanical ynamics, vibration testing, and fe sciences.

107. CBS ELECTRONIC VIDEO RECORDING—In normal use, EVR cassettes are close to indestructible. But if dropped on a hard surface they may separate. The CBS Electronic Video Recording Div. has prepared an illustrated booklet demonstrating re-assembly and outlining procedure for ordering cassette parts.

122. RENTAL ELECTRONICS, INC.—The new 60-page catalog includes rental information for such general purpose test equipment as analyzers, bridges power supplies, generators, amplifiers, oscilloscopes, counters, and meters. Instrument rentals can be offered by REI for as little as one week but are usually of one to six months' duration. Equipment is housed at seven nationwide inventory centers and can be supplied to the customer within 24 hours. All equipment listed in the catalog is owned and held in rental inventory which includes equipment from most leading instrument manufacturers.

ADVERTISERS' INDEX

PROFESSIONAL SERVICES

Equipment for Sale

"New & Used Towers, Buy, Sell or Trade. Erect. Ground wire 85¢ lb. Bill Angle. 919-752-3040. Box 55. Greenville, N.C. 27834." 2-71-tf

HELIAX—STYROFLEX. Large stocks—bargain price — tested and certified. Write/call for price and stock list. Sierra-Western Electric. Box 23872, Oakland, Calif. 94623. Tele: (415) 832-3527. 1-71-tf

ONE STOP for all your professional audio requirements. Bottom line oriented. F. T. C. Brewer Company. P. O. Box 8057. Pensacola, Florida 32505. 7-71-tf

CARTRIDGE TAPE EQUIPMENT—Completely rebuilt and reconditioned. Tapecaster and Spotmaster Record/Playbacks $375.00. Playbacks $250. 30-day money-back guarantee. AUTODYNE, P. O. Box 1004. Rockville, Maryland 20850 (301/762-7626). 11-71-tf

USED EQUIPMENT—Pay Cash for FM/AM transmitters, antennas, consoles, etc. Contact: Electrónica Fernández, Box 415, Hato Rey, Puerto Rico 00919, Tel.: 767-3500. 11-71-4t

KTR-1000 COLOR TV MICROWAVE LINKS—NTSC Color TV plus program audio microwave links for studio-xmtr, CATV, etc. Rack mounted. Mfr. Raytheon. 25 sets in stock, as new condition. Radio Research Instrument Co., Inc., 3 Quincy Street, Norwalk, Conn. Tel. 203-853-2600. 12-71-4t

MOTORS FOR SPOTMASTERS
NEW Paps hysteresis synchronous motor HSZ 20.50-4-470D as used in series 400 and 500 machines. Price $39.00 each prepaid, while they last. 90 day warranty. Terms check with order only, no COD's. Not recommended for Tapecaster series 600 or 700.
TAPECASTER TCM, INC. Box 662, Rockville, Maryland 20851.
1-72-TF

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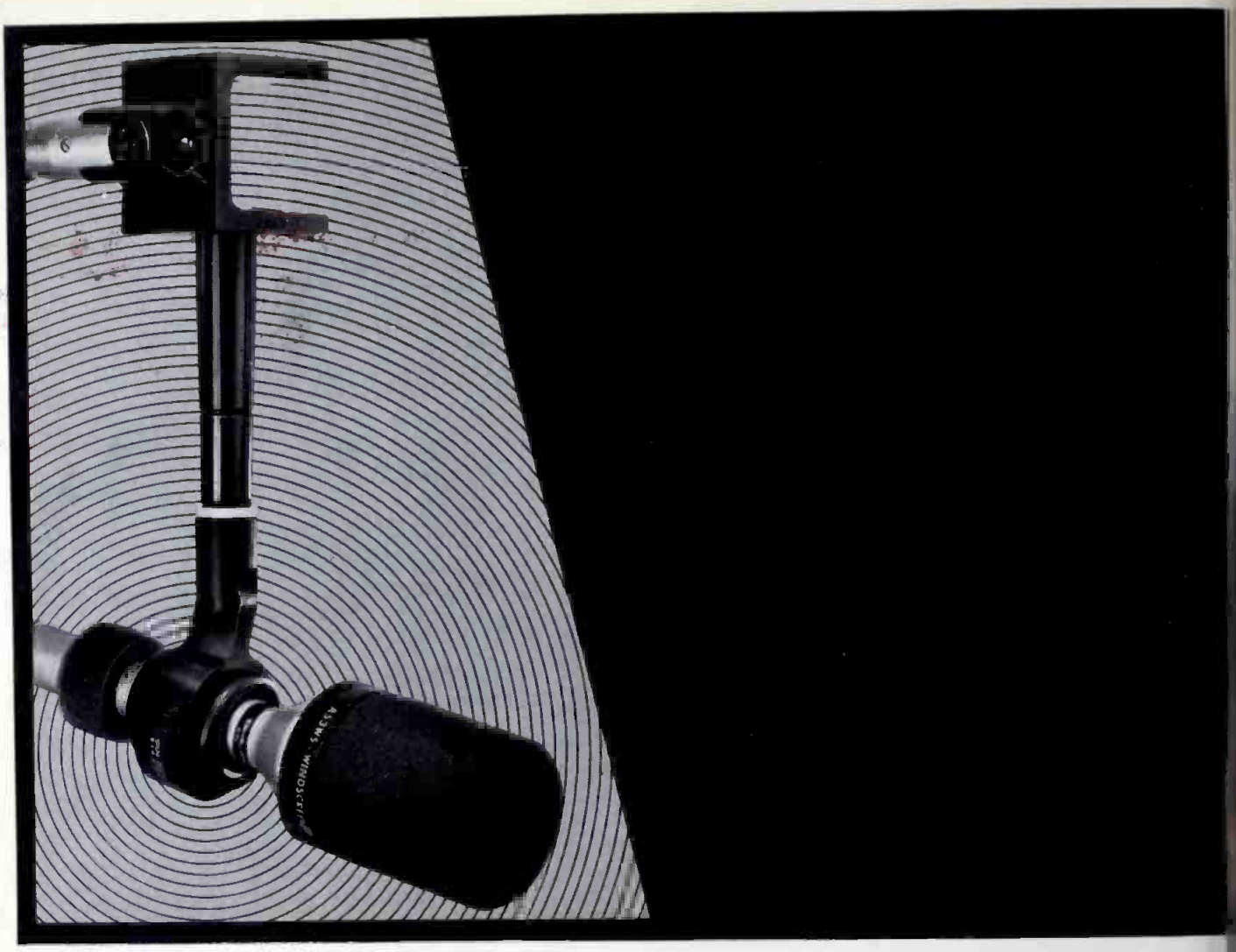

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