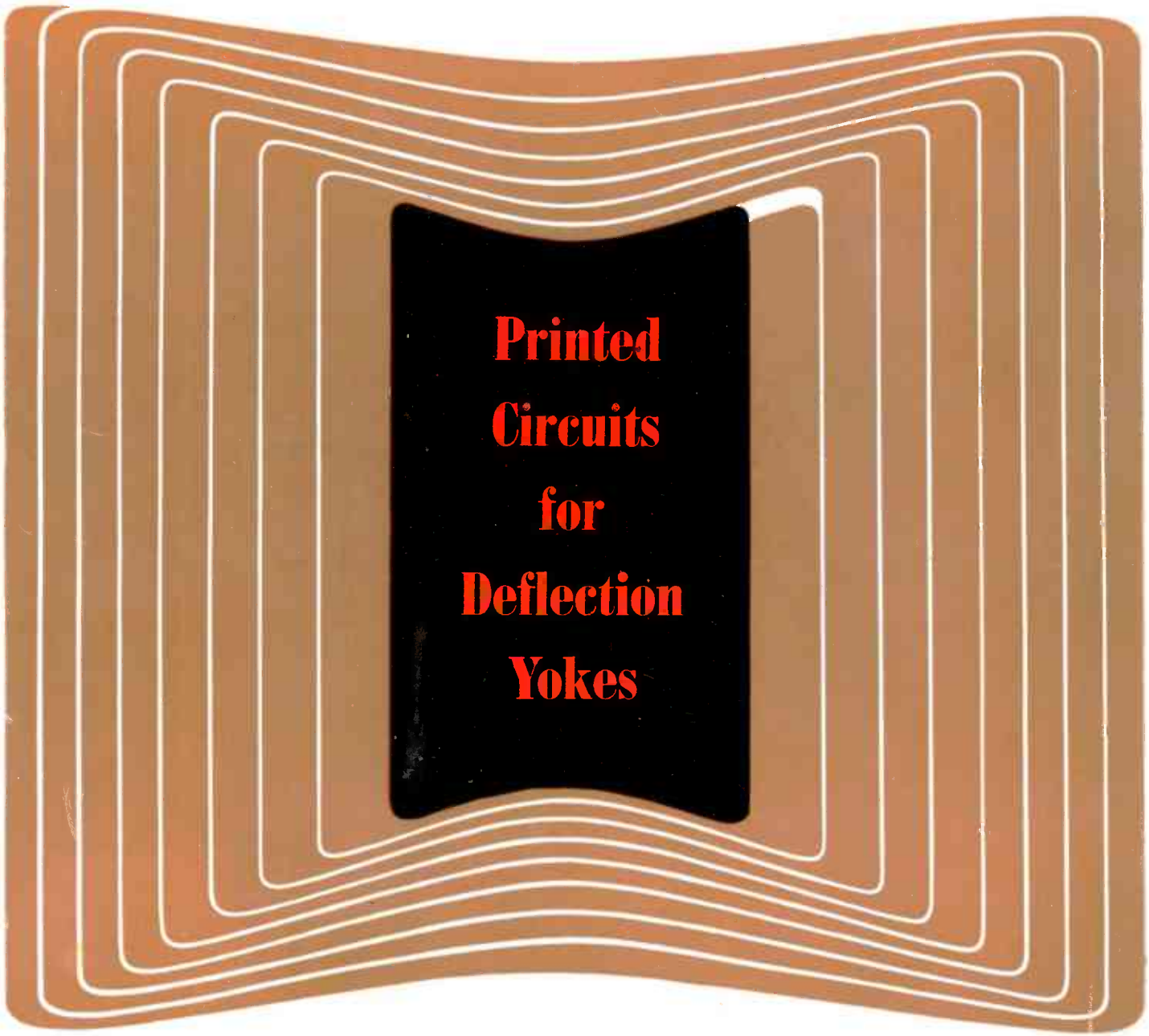
TELE-TECH

& Electronic Industries



Silicon Fusion Transistors
Glow Transfer Tubes in Counting Circuits

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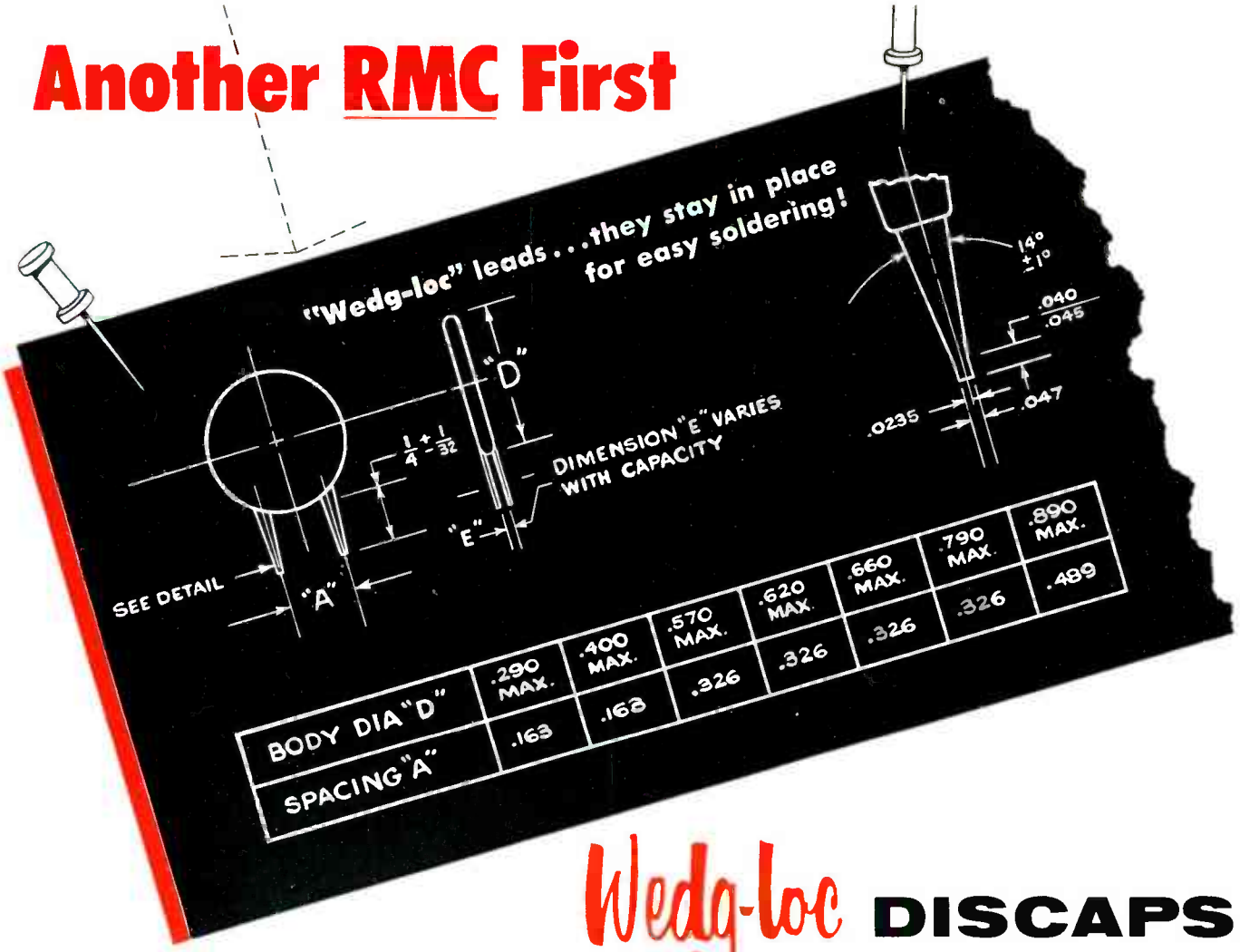
December • 1954

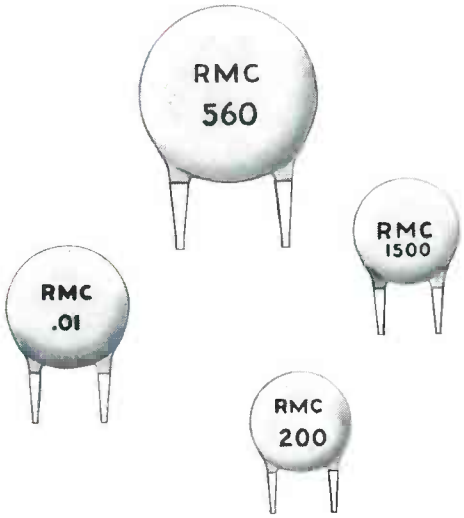
Another RMC First



BODY DIA "D"	.290 MAX.	.400 MAX.	.570 MAX.	.620 MAX.	.660 MAX.	.790 MAX.	.890 MAX.
SPACING "A"	.163	.168	.326	.326	.326	.326	.489

Wedg-loc DISCAPS

for printed wire circuits



The exclusive wedge design of the leads on these new DISCAPS lock them securely in place on printed circuit assemblies prior to the soldering operation. The "Wedg-loc" leads eliminate the possibility of the capacitors becoming loose or falling out. Application of "Wedg-loc" lead DISCAPS to your printed circuits will cut production time, reduce costs, and insure the uniformity of your soldered connection.

"Wedg-loc" DISCAPS are available in capacities between 2 MMF and 10,000 MMF in temperature compensating, by-pass, and stable capacity types with lead spacing as shown above. Electrical specifications and tolerances are the same as standard wire lead DISCAPS. Your inquiry is invited.

ANOTHER NEW DEVELOPMENT FROM THE RMC TECHNICAL CERAMIC LABORATORY

DISCAP CERAMIC CAPACITORS

RMC

RADIO MATERIALS CORPORATION

GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.

FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

Two RMC Plants Devoted Exclusively to Ceramic Capacitors

TELE-TECH & Electronic Industries

DECEMBER, 1954

FRONT COVER: PRINTED CIRCUITS FOR DEFLECTION YOKES—Closeup view of new printed circuit crossed field type coil developed by French designers. These yokes reportedly developed the same deflection as conventional ferrite cored types. See page 82 for additional details. Use of printed circuits throughout the electronic industries is growing by leaps and bounds. One foil-clad laminate manufacturer predicts that each TV set will eventually require a pound of clad-laminate stock. Radio sets, computers, hearing aids, office equipment, automotic signaling devices, hi-fi units are other areas of application now under development.

DEPARTMENTS

TELE-TECH & ELECTRONIC INDUSTRIES*, Vol. 13, No. 12. Published monthly by Caldwell-Clements, Inc. M. Clements, President; M. H. Newton, Assistant to President; John J. Barghi, Vice President and Secretary; M. B. Clements, Treasurer. Acceptance under section 34.64 Postal Laws and Regulations authorized at Bristol, Conn., June 9, 1954. Additional acceptance at New York, N. Y. 75¢ a copy. Subscription Rates: United States and U. S. Possessions: 1 year, $5.00; 2 years $8.00; 3 years $10.00. Canada: 1 year $7.00; 2 years $11.00; 3 years $14.00. All other countries: 1 year $10.00; 2 years $16.00. Please give title, position and company connections when subscribing. Printed in U.S.A.

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announcing

MODEL TCR-12

RAYTHEON **TELELINK**

A NEW MICROWAVE SYSTEM

Engineered for Reliable Service at Low Cost

INDUSTRIAL BAND and COMMON CARRIER BAND Applications

(6575-6875 mc) **(6250-6425 mc)**

Marking a big step forward in microwave economy, reliability and ease of installation, Raytheon presents the Model TCR-12 TELELINK. Available for one or two channel operation, TELELINK is particularly applicable for handling telephone, telemetering, teletype, telegraph, control and VHF functions.

SINGLE-PACKAGE UNITS. Completely self-contained including built-in parabolic antenna and all-weather radome, TELELINK units are quickly and easily installed on poles or towers and may be used with passive reflectors. TCR-12 repeater units permit multi-hop systems.

Simple, compact, rugged, designed for trouble-free, unattended operation in all weather, TELELINK features long-life circuits and automatic self-tuning after power failures or maintenance shut-downs. Operates on standard utility power.

PRINTED CIRCUIT TECHNIQUES . . . First to use strip line plumbing with printed circuit techniques, Raytheon TELELINK incorporates latest design features for reliability, economy, compactness, and servicing ease.

RELIABLE, LOW COST MICROWAVE SERVICE FOR

PIPELINES	PUBLIC WORKS
POWER UTILITIES	FIRE AND POLICE
TELEPHONE COMPANIES	AIRLINES
TURNPIKES	RAILROADS
HIGHWAYS	FORESTRY

MILITARY AND CIVIL DEFENSE

DETAILED INFORMATION . . . a new brochure contains complete data on the new Raytheon TELELINK. Write for it.

RAYTHEON

Specialists in Microwave for Television and Communications

RAYTHEON MANUFACTURING COMPANY

Equipment Sales Division

WALTHAM 54, MASSACHUSETTS

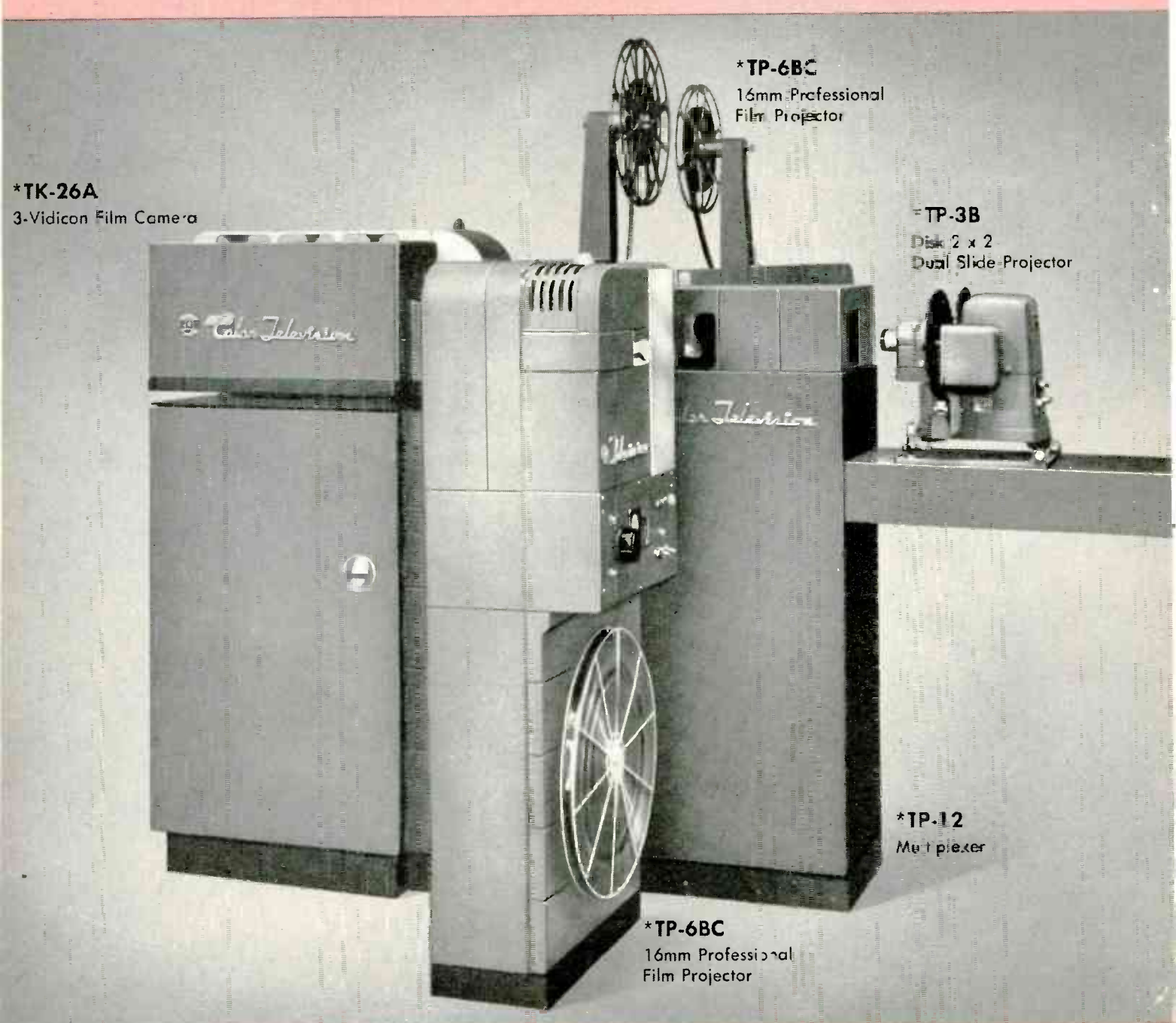
Foreign Purchases of U. S. Electronic Equipment

A summary of sales from January to June 1954. Compiled from Bureau of Census reports FT-410, United States Department of Commerce

COUNTRY	Radio TV Xmitting Equip'mt.	Auto. Radio Receivers	Radio-Phono Comb.	Home Receivers	Receiver Chassis	TV Receiver Sets Home Type	TV Receiver Chassis No Cabinets	Electron Tubes	TV Camera CRT's	TV Picture Receiving Tubes CR	Crystal Diodes and Transistors	Capacitors	Resistors	Inductors	Loud Speakers	Electronic Components	Electronic Accessaries	Public Address & Audio	Totals
ANGOLA	$ 11,421	$	$ 1,832	$	$	$	$	$ 999	$	$	$	$	$	$	$	$	$ 632	$	$ 14,884
ARGENTINA	50,939	4,410	.....	.....	.....	96,196	.....	128,905	7,765	56,786	1,275	6,626	1,856	5,104	2,100	17,200	56,003	12,150	447,955
AUSTRALIA	1,857	.....	.....	.....	.....	.....	.....	35,638	.....	.....	1,972	25,836	1,710	3,330	.....	19,911	10,073	1,615	69,109
AUSTRIA	28,000	.....	.....	.....	.....	.....	.....	.....	3,315	.....	.....	637	.....	.....	1,519	.....	.....	.....	33,471
BAHAMAS	750	.....	4,431	602	.....	2,734	703	593	.....	.....	.....	.....	.....	1,900	.....	.....	.....	.....	14,190
BELGIUM & LUXEMBURG	.....	37,671	.....	600	.....	515	.....	156,409	30,600	86,496	1,708	42,818	17,738	10,611	26,874	76,780	19,062	2,669	510,551
BOLIVIA	.....	.....	1,503	.....	.....	.....	.....	7,537	.....	.....	.....	2,477	900	.....	.....	2,971	.....	.....	12,911
BRAZIL	26,415	7,180	12,584	20,608	80,224	746,104	529,733	976,665	8,550	271,759	5,200	239,696	165,594	121,695	171,648	208,887	30,509	53,351	3,686,402
BRITISH MALAYA	2,980	.....	796	543	.....	.....	.....	705	.....	.....	.....	1,523	.....	.....	4,330	2,750	2,750	6,583	22,960
BURMA	97,961	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	800	595	20,121	.....	.....	.....	.....	119,477
CANADA	1,431,852	50,326	20,319	175,375	14,139	716,894	52,158	1,723,399	62,769	1,102,883	25,548	1,057,581	430,059	926,123	167,416	4,307,730	2,515,750	192,032	14,972,353
CHILE	7,164	10,191	550	.....	.....	2,183	.....	20,614	.....	.....	.....	1,973	2,140	2,969	1,380	2,058	3,061	3,111	54,394
COLOMBIA	254,026	168,358	112,594	283,539	87,157	61,912	.....	121,886	6,545	.....	.....	48,589	12,361	91,433	65,538	68,694	121,492	155,101	1,659,225
COSTA RICA	683	14,466	2,968	55,807	1,674	.....	.....	4,760	.....	.....	.....	1,886	.....	650	3,136	3,520	1,896	1,828	93,274
CUBA	18,369	59,301	22,769	141,607	10,611	1,780,713	757	181,129	22,556	111,888	.....	12,076	9,190	32,417	8,967	33,610	51,635	14,586	2,512,181
DENMARK	.....	.....	.....	.....	.....	.....	.....	11,220	6,725	.....	15,030	750	354	849	.....	4,270	1,050	2,593	42,841
DOMINICAN REPUBLIC	38,761	11,764	4,753	13,827	.....	3,215	.....	5,261	4,800	530	.....	.....	.....	9,914	531	525	1,053	2,590	97,524
ECUADOR	2,264	634	.....	31,567	.....	.....	.....	12,400	.....	.....	.....	567	.....	3,311	2,806	.....	2,292	12,147	67,988
EGYPT	3,597	.....	1,694	19,239	.....	.....	.....	508	.....	.....	.....	678	.....	.....	2,581	.....	.....	5,195	33,492
EL SALVADOR	.....	4,450	6,351	32,551	.....	.....	.....	3,749	.....	.....	.....	1,135	627	750	.....	872	5,262	4,901	60,648
FRANCE	27,411	3,226	6,280	6,443	.....	.....	.....	253,600	5,484	67,019	31,629	36,028	95,585	37,016	7,193	86,600	13,727	5,947	683,188
FRENCH MOROCCO	4,879	25,817	2,178	21,973	.....	.....	.....	1,580	4,300	784	.....	105	.....	.....	107	.....	4,569	.....	66,292
FRENCH WEST AFRICA	3,842	.....	.....	.....	.....	.....	.....	4,203	.....	.....	.....	.....	.....	4,630	834	.....	.....	3,889	17,398
GREECE	600	15,888	960	3,462	.....	.....	.....	8,102	7,980	.....	.....	5,864	116	1,999	.....	3,033	.....	1,376	49,380
GUATEMALA	914	4,765	2,980	32,209	.....	.....	.....	6,614	.....	.....	.....	1,119	.....	531	536	739	3,051	11,033	64,607
HAITI	1,025	1,772	569	6,130	.....	.....	.....	.....	.....	.....	.....	613	.....	.....	.....	.....	.....	4,312	16,692
HONDURAS	.....	.....	3,260	14,610	.....	.....	.....	2,271	.....	.....	.....	.....	.....	.....	.....	2,056	1,652	5,111	28,960
HONG KONG	.....	.....	.....	5,877	.....	.....	.....	.....	.....	.....	.....	503	.....	.....	745	1,771	.....	3,416	12,312
INDIA	4,897	.....	.....	.....	.....	.....	.....	3,839	.....	.....	628	1,490	3,299	15,733	10,017	5,343	121	19,899	65,263
INDOCHINA	38,173	.....	.....	1,718	.....	.....	.....	3,925	.....	.....	.....	130,104	9,342	3,361	.....	13,285	1,395	24,000	225,303
INDONESIA	.....	.....	.....	.....	.....	1,332	.....	48,638	1,035	.....	.....	3,170	4,397	16,429	1,568	12,894	34,480	1,371	125,314
IRAN	.....	14,989	5,271	130,415	1,175	.....	.....	28,988	.....	.....	.....	.....	900	2,471	.....	540	2,220	9,547	194,516
IRAQ	.....	13,898	650	38,694	.....	.....	.....	1,798	.....	.....	.....	.....	.....	.....	741	.....	4,394	752	60,927
ISRAEL	5,526	19,136	.....	.....	.....	.....	.....	20,580	.....	.....	.....	1,099	6,802	2,849	.....	4,225	5,865	570	66,652
ITALY	69,719	.....	24,494	12,340	.....	864,246	121,006	110,279	40,120	763,482	3,730	12,932	9,009	33,302	5,614	67,058	16,536	5,452	2,159,319
JAPAN	380,001	36,346	553	9,510	.....	25,969	3,800	39,686	42,860	49,735	5,200	10,055	841	3,292	.....	11,729	11,636	6,539	638,140
KOREA	690,990	.....	.....	1,691	.....	.....	.....	1,295	.....	.....	.....	.....	.....	1,125	.....	.....	.....	.....	695,101
KUWAIT	.....	17,642	.....	14,192	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	162,407
LEBANON	935	2,889	3,480	14,409	.....	.....	.....	1,173	.....	.....	.....	.....	.....	.....	562	1,100	12,115	573	24,682
MEXICO	340,772	89,330	26,167	82,335	218,235	299,484	2,150,894	517,175	30,422	237,136	566	201,549	47,064	159,242	73,180	426,060	192,518	102,491	5,194,620
NETHERLANDS	1,117	753	.....	.....	5,144	52,400	.....	17,171	5,087	.....	5,422	27,870	3,605	12,298	2,041	27,487	1,200	1,088	162,683
NETHERLANDS ANTILLES	1,200	1,707	8,555	592	.....	.....	.....	6,514	.....	.....	.....	.....	.....	.....	.....	1,249	713	1,984	22,514
NICARAGUA	.....	4,254	525	10,295	.....	.....	.....	4,448	.....	.....	.....	.....	789	1,731	3,115	2,652	540	2,558	30,383
NORWAY	9,162	.....	.....	.....	.....	.....	.....	8,059	.....	.....	920	630	691	158	550	7,784	.....	.....	27,954
PAKISTAN	17,292	.....	.....	.....	.....	.....	.....	1,256	.....	.....	.....	.....	552	1,699	528	844	7,319	6,453	35,943
PANAMA	.....	1,620	2,585	15,537	.....	32,302	.....	3,483	.....	.....	.....	.....	.....	.....	581	5,563	1,756	2,871	66,298
PERU	95,477	7,261	6,731	47,492	.....	3,090	.....	15,188	.....	.....	.....	3,246	1,718	5,504	3,406	15,570	3,010	12,208	219,901
PHILIPPINES	65,479	1,713	2,022	183,057	30,245	31,654	16,320	104,903	.....	1,246	.....	60,927	44,224	56,382	172,901	35,568	34,569	37,553	878,753
PORTUGAL	31,692	1,498	750	1,461	.....	.....	.....	11,080	.....	.....	.....	7,590	565	2,127	7,580	.....	1,950	2,963	69,256
REPUBLIC OF INDONESIA	595,331	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	595,331
SAUDI ARABIA	7,941	3,467	.....	13,726	.....	.....	.....	4,351	.....	.....	.....	4,535	.....	9,789	.....	3,742	4,113	.....	51,664
SPAIN	13,852	.....	3,432	.....	.....	.....	540	12,687	.....	.....	4,948	1,315	6,637	3,121	.....	2,060	.....	1,627	50,219
SWEDEN	3,882	12,928	.....	.....	.....	.....	.....	54,714	.....	.....	3,142	9,626	3,423	.....	.....	12,016	638	13,688	114,057
SWITZERLAND	12,220	10,341	3,173	4,202	.....	190,835	.....	50,847	18,620	3,550	1,061	8,419	26,370	4,345	3,129	20,299	10,698	7,360	375,469
SYRIA	.....	2,898	725	9,253	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4,120	1,385	18,381
TAIWAN	.....	.....	.....	51,437	941	.....	.....	34,025	.....	.....	.....	3,813	4,452	9,013	15,192	.....	.....	8,927	127,800
TANGIER	.....	3,224	.....	20,225	.....	.....	.....	11,229	.....	.....	.....	1,496	578	.....	.....	.....	.....	.....	36,752
THAILAND	146,474	.....	.....	16,807	.....	2,700	.....	13,395	2,925	.....	.....	3,728	.....	26,790	6,234	1,592	.....	47,231	267,876
TURKEY	9,364	.....	642	.....	.....	.....	.....	8,306	.....	.....	.....	4,907	876	8,968	.....	2,938	864	3,683	40,548
UNION OF SOUTH AFRICA	2,368	.....	.....	7,039	.....	.....	.....	39,858	.....	.....	.....	32,268	5,496	4,259	3,254	9,061	7,669	8,020	119,292
UNITED KINGDOM	2,899	.....	.....	28,167	.....	.....	.....	44,416	11,648	3,682	2,389	80,968	2,535	14,153	884	56,476	21,454	6,810	276,481
URUGUAY	.....	.....	1,750	1,281	.....	3,050	.....	6,134	.....	1,553	.....	2,815	.....	1,362	1,275	3,142	245	.....	22,607
VENEZUELA	154,849	162,033	133,084	208,330	.....	1,099,126	33,011	92,761	4,800	63,772	754	19,348	9,128	45,488	32,287	58,390	166,774	66,534	2,350,469
WEST GERMANY	41,747	.....	.....	572	.....	.....	.....	89,255	18,875	69,991	14,490	8,071	5,046	2,724	.....	36,214	.....	.....	286,955
YUGOSLAVIA	1,600	.....	.....	.....	.....	.....	.....	11,162	.....	.....	.....	.....	764	3,513	.....	.....	520	22,050	39,609

"3-V"*

The Color-TV Film Camera that outmodes all other approaches



NEW SIMPLIFIED DESIGN

The RCA TK-26A uses 3 small, inexpensive Vidicon cameras to handle red, green, and blue individually (see diagram)—and a fixed lens-and-dichroic mirror system—for handling color separation. *Electronic control* assures precise registration of the three cameras for day-in, day-out operation. Here is the color film system that not only handles 16- and 35-mm motion picture film—*but slides as well!*

UNMATCHED PICTURE QUALITY

Resolution and stability are unmatched by any other approach. Gamma is ideal—needs virtually no correction. Color fidelity equals the high-quality standards set by RCA's studio color camera. Exceptional stability and precise picture registration are characteristics that assure simplicity and ease of operation and a minimum of maintenance. Ample reserve of light assures best possible pictures from the densest of films.

NEW, EASY MULTIPLEXING

As simple and straightforward as any monochrome arrangement, the TK-26A includes all facilities needed for color film programming—slides, film, and multiplexer. You can interchange slides, and 16- and 35-mm film—just like you do with black and white.

EMPLOYS STANDARD TYPE PROJECTORS

RCA's TK-26A Film Camera System works with standard type television projectors such as the RCA TP-6BC. You get ample light to handle dense films—and at the same time you avoid complicated projector equipment involving moving optical parts. RCA's equipment operates with "station tested" reliability.

RCA TK-26A

NOW, "STUDIO REALISM" IN COLOR —WITH 16MM, 35MM COLOR FILM AND SLIDES

The search for high quality in a Color-TV film and slide camera is ended!

After several years of intensive work with almost every conceivable approach to color film and slide reproduction, RCA Broadcast Design Engineers have now produced a superior film camera system matched by no other. This is the color film system that has outperformed . . . flying-spot scanners . . . fast pull-down systems . . . continuous motion arrangements . . . in actual side-by-side tests at the RCA Engineering Laboratories. This is the color film system that RCA has now *adopted over its own previous "flying-spot scanner."*

For complete technical information on the TK-26A—the remarkable RCA 3-Vidicon color film camera that outmodes all other approaches—call your RCA Broadcast Sales Representative. In Canada, write RCA Victor Ltd., Montreal.

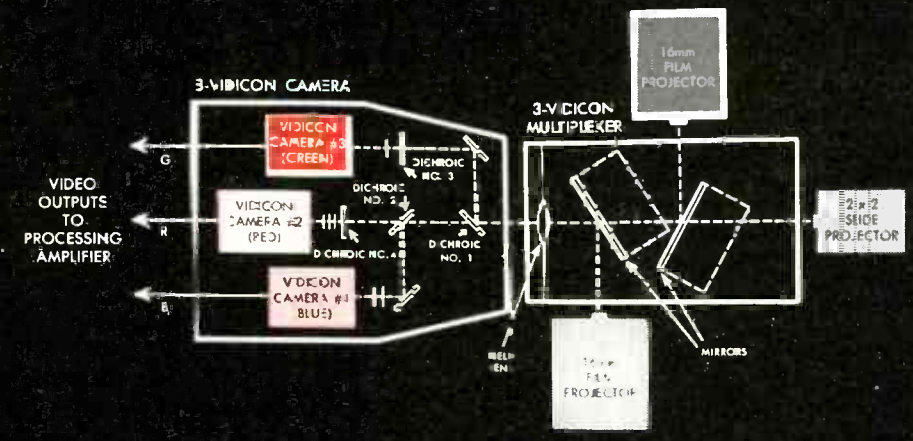
*Close-up view of the TK-26A — RCA's remarkable 3-V Color Film Camera. Heart of the 3-V is the revolutionary new, inexpensive Vidicon Camera tube—RCA-6326!

Important for Station Men—new brochure on RCA's 3-Vidicon Camera Chain. Free, from your RCA Broadcast Sales Representative.

RCA Pioneered and Developed Compatible Color Television

How It Works!

Light from either one of three selected color picture projectors passes into the 3-V Multiplexer. A remotely-controlled mirror arrangement reflects the incoming image through a field lens and into the 3-V Camera. Here, dichroic mirrors and color filters "split" the light into three color components—green, red, and blue. Each color component produces a VIDEO signal in a separate Vidicon camera. Video output from each camera then goes into the Processing Amplifier in the camera control unit.



RCA

RADIO CORPORATION of AMERICA

ENGINEERING PRODUCTS DIVISION CAMDEN, N. J.

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& Electronic Industries

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TELE-TECH* & ELECTRONIC INDUSTRIES is edited for top-level engineers and executives throughout the electronic industries. It gives the busy engineering executive authoritative information and interpretation of the latest developments and new products, with emphasis on subjects of engineering import and timeliness. Special attention is given to:

MANUFACTURING

—Electronic equipment, communications, broadcasting, microwave relay, instrumentation, telemetering, computing.
—Military equipment including radar, sonar, guided missiles, fire controls.
—TV-FM-AM receivers, phonographs, recorders, reproducers.

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—Fixed, mobile and airborne communications in commercial, municipal, aviation and government services.
—Broadcasting, Color TV, video and audio recording, records, audio and sound systems, motion picture production.
—Military, civilian and scientific electronic computing and control systems.
—*Reg. U. S. Pat. Off.

THE ELECTRONIC INDUSTRIES DIRECTORY

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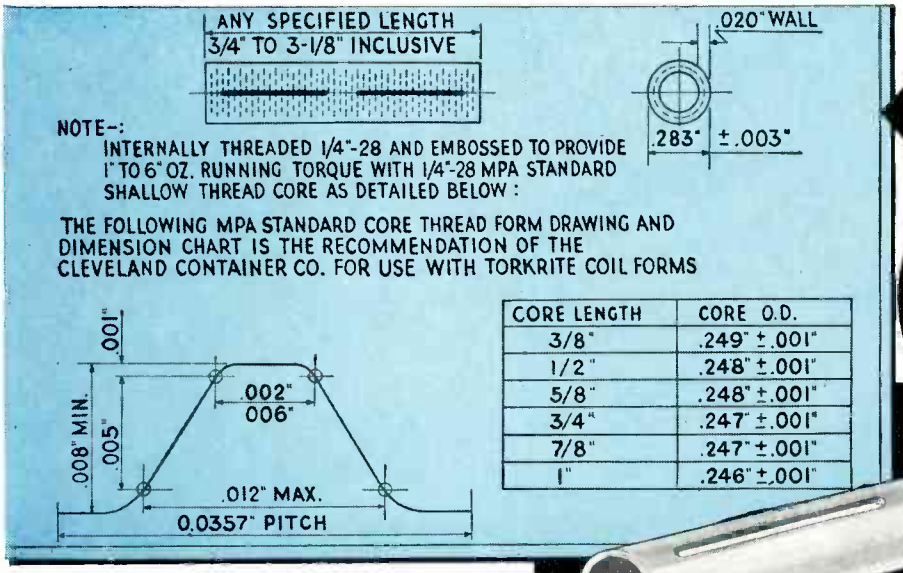
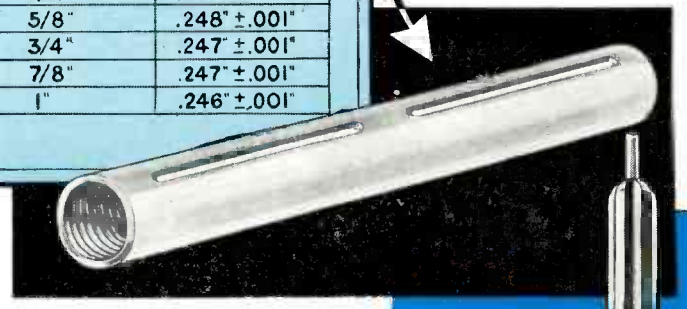


DESIGN

PRODUCT

APPLICATION

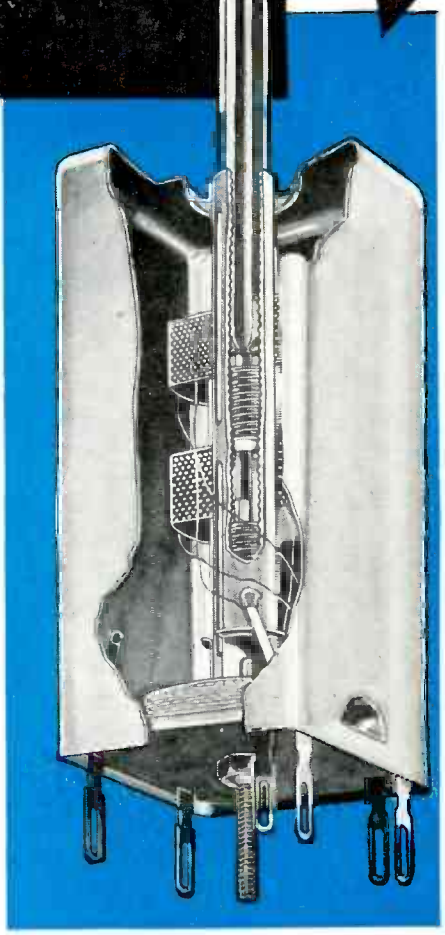


TORKRITE

BY THE MAKERS OF CLEVELITE* PHENOLIC TUBING

Torkrite coil forms eliminate torque and stripping problems and are rapidly replacing other coil forms because Torkrite:

- withstands more than required stripping pressure.
- requires no revision other than reduced winding arbor diameter.
- is round and concentric; winds coils at higher speed without wire breakage or fallen turns.
- permits use of lower torque since it is completely independent of stripping pressure.
- recycling ability is unmatched.
- is stronger mechanically because of heavier wall.
- provides 1-6" oz. running torque when used with MPA standard shallow thread core.
- has no holes or perforations thru tube wall which eliminates cement leakage locking cores.
- has smooth adjustment of core without lubricant.
- torque increases less after winding as heavier wall reduces any tendency to collapse and bind core.
- maximum stability results as core cannot move in relation to winding after peaking as it is engaged in internal threads.
- embossings are evenly spaced, with a lead at each end of the form to permit easy insertion of core.



INVESTIGATE this outstanding coil form.

*Reg. U. S. Pat. Off.

Why pay more? For good Quality . . . Call CLEVELAND!

★ ★ ★

Improved new Torkrite is now available in various diameter tubes. Lengths from 3/4" to 3-1/8" are made to fit 8-32, 10-32, 1/4-28 and 5/16-24 cores.

★ ★ ★

The CLEVELAND CONTAINER Co.
6201 BARBERTON AVE. CLEVELAND 2, OHIO

PLANTS AND SALES OFFICES at Chicago, Detroit, Memphis, Plymouth, Wisc., Ogdensburg, N.Y., Jamesburg, N. J.
ABRASIVE DIVISION at Cleveland, Ohio
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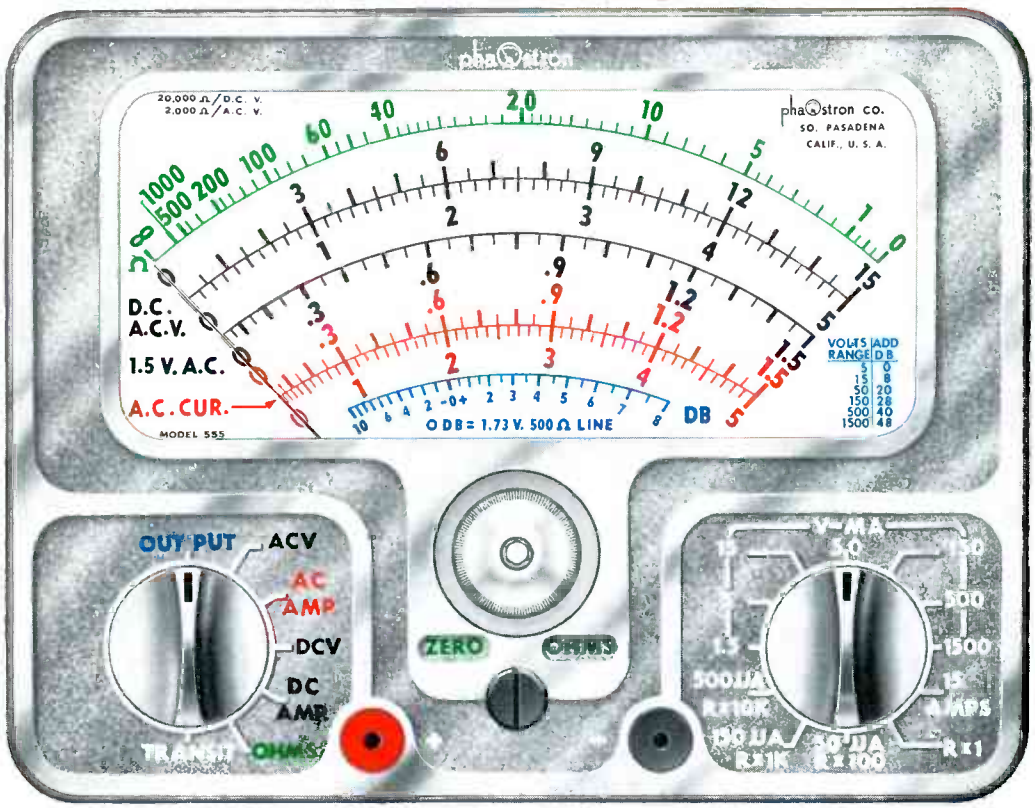
WEST COAST IRV. M. COCHRANE CO., 408 S. ALVARADO ST., LOS ANGELES

the KEY to your problem

phaostron

"555" metal-cased MULTIMETERS

the NEW LOOK in



POCKET SIZE WITH A 4 7/8" LENGTH SCALE

WE LEAVE IT TO YOU

WOULD YOU BUY A PLASTIC-CASED WRIST WATCH . . .

if you *could* buy the finest movement in a magnetically shielded metal case?

Phaostron, world famous manufacturer of ENVIRONMENT FREE PRECISION AIRCRAFT EQUIPMENT for Military and Industrial uses introduces a new concept in Multimeters. This magnetically shielded, metal-cased "555" compares with plastic-cased multimeters as a fine watch in a precious metal case would compare with a plastic wrist watch.

The shielded, shatterproof and anti-magnetic case insures continued accuracy and integrity of this instrument for years to come.

Phaostron "555" Multimeter incorporates more ranges, including AC current, greater visibility, simplified and functional controls and the greatest value offered to date.

See the Phaostron "555", note its many outstanding features, its beautiful satin chrome case, its compactness and light weight, and you will know why

the KEYS to your problems

- phaostron AC CURRENT RANGES
- phaostron ANTI-MAGNETIC . . . DOUBLY SHIELDED
- phaostron LARGE SCALES . . . COLOR CODED
- phaostron SIMPLICITY . . . ONLY 2 JACKS
- phaostron ACCURACY . . . 2% DC, 3% AC
- phaostron GREATER RANGES . . . 3 TO 1 STEPS
- phaostron FASTER & FUNCTIONALLY EASIER *to use and read*

"YOU CANNOT BUY BETTER" **PRICE $39.95 at your PARTS DISTRIBUTOR**

Manufactured by PHAOSTRON COMPANY • 151 Pasadena Avenue • South Pasadena, Calif., U.S.A.

THE **ONE** INSTRUMENT YOU NEED FOR Color

JACKSON COLOR BAR / DOT GENERATOR

Signal Outputs

1. Composite video of either polarity, adjustable amplitude to 2 volts across 90 ohms.
2. Modulated R.F., channels 3 through 5, 0.1 volt across 300 ohms.
3. Horizontal sync., positive polarity, 1 volt across 200 ohms.
4. Color subcarrier, 4 volts across 200 ohms at burst phase.

Synchronizing Signals

1. Horizontal sync. and blanking (F.C.C. standards).
2. Vertical sync., serrated and locked to horizontal.
3. Vertical blanking.
4. Color burst (N.T.S.C. standards).

Video Signals

1. Dots (nominal 108 dots)
2. Crosshatch (nominal 12 by 9)
3. Color bars (5 switch positions)

Position 1—Multi.

8 Bars in the following sequence:

1. White, relative luminance 1.0, chrominance zero
2. Yellow, relative luminance 0.89, chrominance 0.44
3. Cyan, relative luminance 0.70, chrominance 0.63
4. Green, relative luminance 0.59, chrominance 0.59
5. Magenta, relative luminance 0.41, chrominance 0.59
6. Red, relative luminance 0.30, chrominance 0.63
7. Blue, relative luminance 0.11, chrominance 0.44
8. Black, relative luminance zero, chrominance zero

Luminance and chrominance held to 10 percent, phase angles to ±5 degrees

Position 2—Color Difference.

7 Bars of zero luminance in the following sequence:

1. Black, relative chrominance zero.
2. I, relative chrominance 0.25
3. Q. relative chrominance 0.25
4. Black, relative chrominance zero
5. R-Y, relative chrominance 0.25
6. B-Y, relative chrominance 0.25
7. Black, relative chrominance zero

Phase angles held to ±2 degrees.

Positions 3, 4 and 5—Single bars, luminance 0.3, chrominance 0.5, occupying approximately 60% of screen width.

1. Red (position 3)
2. Green (position 4)
3. Blue (position 5)

Sound Carrier, approximately 25% of peak picture carrier, placed 4.5 megacycles from picture carrier.

Panel Controls

1. R.F. carrier tuning, channels 3 through 5.
2. Video output amplitude.
3. Horizontal lock.
4. Standby switch (sound on, sound off).
5. Video output polarity switch.
6. Power switch.
7. Function switch (crosshatch — dots — color bars)
8. Color bar switch (Multi, Color Diff., Red, Green, Blue).

Internal Adjustments

1. Burst amplitude.
2. 3.58 frequency vernier.
3. Sync. lock controls.

Tube Complement

12AT7 — 8	6J6 — 10
12AX7 — 4	5U4-G — 1
6AL5 — 1	6BJ7 — 1

Circuit Operation

1. Color sub-carrier and sound frequencies are determined by crystal oscillatars.
2. Color phase angles are determined by an accurate, low impedance delay line.
3. Direct gating of proper chrominance phase is employed for each color bar to attain maximum stability and reliability rather than usual methods utilizing quadrature encoders.
4. Serrated vertical sync. is maintained an integral divisor of harizontal rate.
5. Luminance and chrominance levels are reliable and stable. No multivibrators are employed in generating color bars.
6. No internal or external adjustments are necessary for proper bar widths, luminance or chrominance levels. For use on 105-125 volts 60 cycle AC.

Physical Characteristics

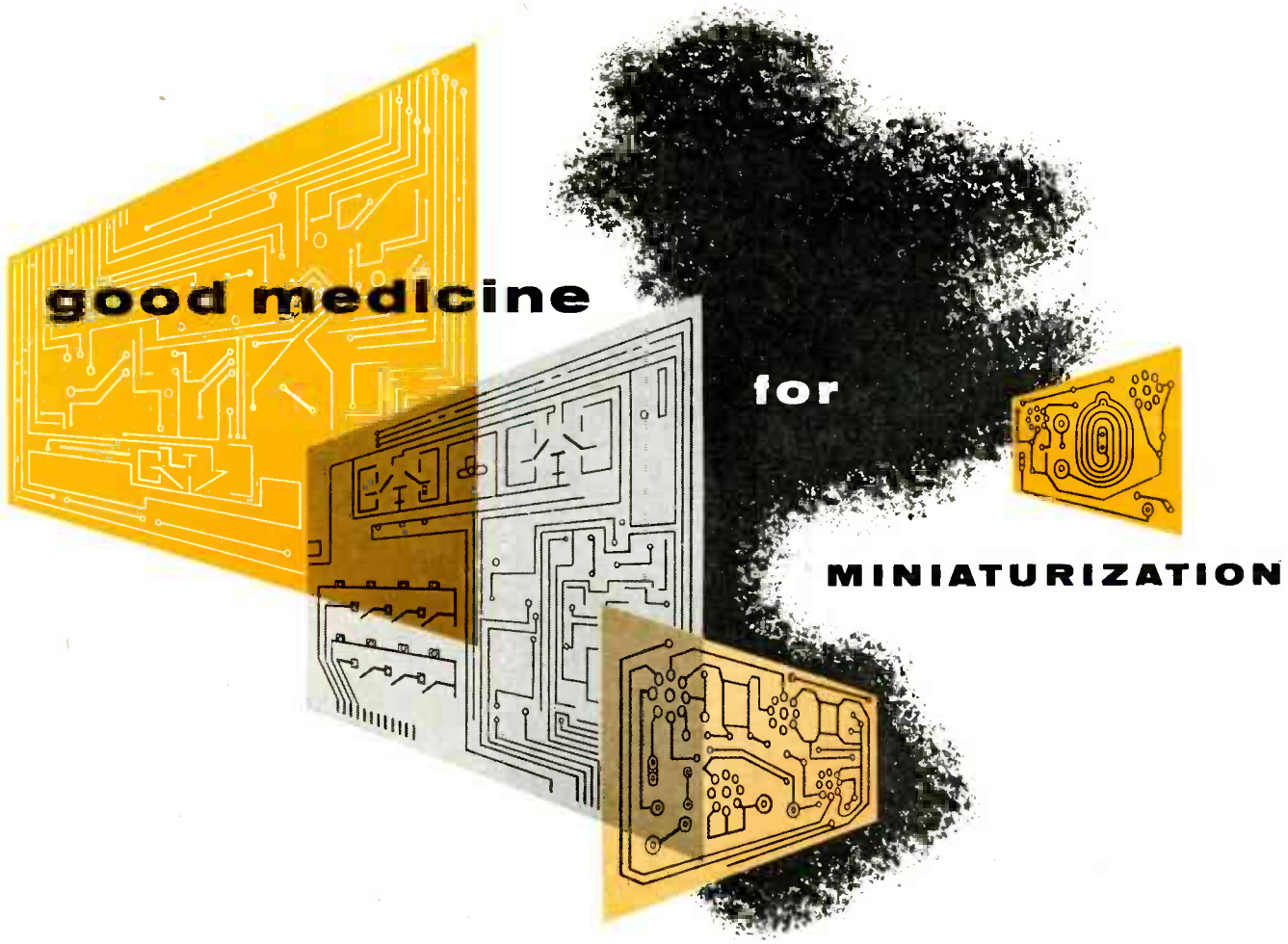
Dimensions— 16½" wide x 9½" high x 10¼" deep. Designed to match other Jackson TV Equipment, both in styling and exterior dimensions.

Weights—27 net pounds. Shipping 32 pounds.

"Service Engineered" Test Equipment

JACKSON ELECTRICAL INSTRUMENT CO.

16-18 South Patterson Boulevard, Dayton 2, Ohio • In Canada: The Canadian Marconi Company



By their very nature, *printed circuits* are extremely compact. They open up virtually unlimited possibilities to alert designers concerned with the miniaturization of electrical and electronic devices. From the simplest switches to the most complex computers, printed circuits are proving their versatility and great potential application.

Complicated manual wiring is replaced by a pattern of conductors, coils, resistors, and other components "printed" on a sheet of laminated plastic. Low in cost, uniform in performance, and free of wiring "bugs," such assemblies are speedily mass-produced. Labor costs are drastically cut two ways—far fewer personnel are needed, and lesser-skilled workers can easily assemble (and service) complex devices with less chance of error. Since exact wiring duplication is achieved, inspection is greatly simplified. Assemblies grow small in size, overhead is reduced, less floor space is needed . . . the whole problem takes a big "easy-does-it" step toward complete automation.

National Vulcanized Fibre Co. is a pace-setter in the development of foil-clad laminates—the basic materials for most printed circuitry. Copper-Clad Phenolite—by National—is recognized as the standard by fabricators everywhere. For Phenolite is a high-quality base laminate that can be *engineered* to fit *your* conditions. It has the high insulation resistance, low electrical loss, and low moisture absorption required in the *right* base material for printed circuits. It is light in weight, easily punched and worked, and withstands effects of the various circuit-printing processes.

No matter which method you use to produce printed circuits, Phenolite clad laminates are the ideal base materials. Whether clad with metal foils, or non-metallic materials (such as rubber, vulcanized fibre, etc.) there is a Phenolite laminate for *your* particular job.

Ask any of our district offices or Wilmington headquarters for details.

PHENOLITE
Laminated PLASTIC

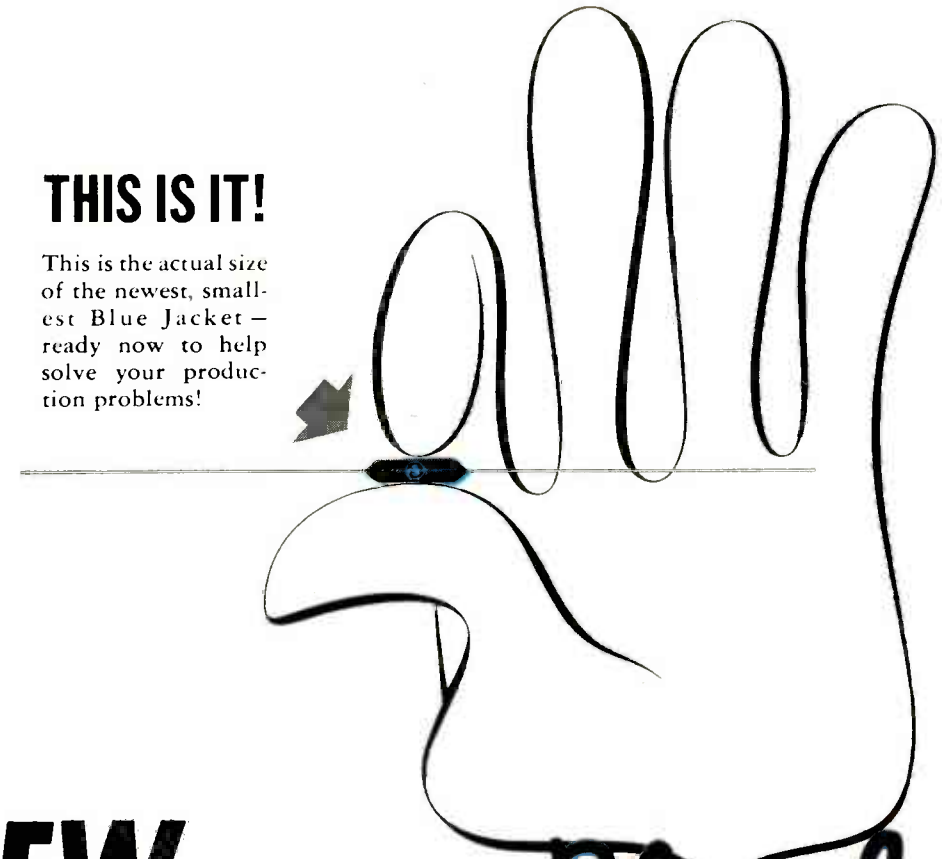
HERE'S HELP FOR YOU—*our new, fact-filled, 12-page bulletin entitled "Mechanize Your Wiring With Copper-Clad Phenolite." Contains full information and application data on Copper-Clad Phenolite and other metal and non-metal clads. Write for it today! Address Dept. A-12.*

Also manufacturers of Vulcanized Fibre, Vul-Cot Waste Baskets, Peerless Insulation, Materials Handling Equipment and Textile Bobbins

NATIONAL
VULCANIZED FIBRE CO.
WILMINGTON 99, DELAWARE

THIS IS IT!

This is the actual size of the newest, smallest Blue Jacket — ready now to help solve your production problems!



NEW...a 3-watt Blue Jacket®
miniaturized axial-lead wire-wound resistor

This power-type wire wound axial-lead Blue Jacket is hardly larger than a match head *but it performs like a giant!* It's a rugged vitreous-enamel coated job—and like the entire Blue Jacket family, it is built to withstand severest humidity performance requirements.

Blue Jackets are ideal for dip-soldered sub-assemblies . . . for point-to-point wiring . . . for terminal board mounting and processed wiring boards. They're low in cost, eliminate extra hardware, save time and labor in mounting!

Axial-lead Blue Jackets in 3, 5 and 10 watt ratings are available without delay in any quantity you require. ★ ★

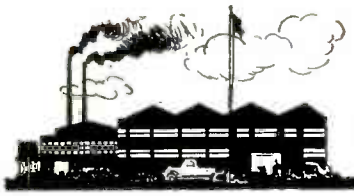
SPRAGUE TYPE NO.	WATTAGE RATING	DIMENSIONS L (inches)	D	MAXIMUM RESISTANCE
151E	3	1 1/32	3/64	6,000 Ω
27E	5	1 1/8	5/16	30,000 Ω
28E	10	1 3/8	5/16	50,000 Ω

Standard Resistance Tolerance: ±5%

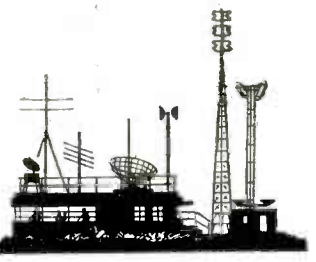
WRITE FOR ENGINEERING BULLETIN NO. 111B

SPRAGUE

SPRAGUE ELECTRIC COMPANY · 233 MARSHALL ST. · NORTH ADAMS, MASS.



As We Go To Press...



New Component Placing System

An automatic system to place components in varied types of electronic equipment sub-assemblies was described recently by George W. Gamble, of the G-E Advanced Electronics Center, Ithaca, N.Y., as a further step toward the automatic factory. The system, with flexibility to switch rapidly from one type of assembly to another, is being built by GE for the Army Signal Corps as an industrial preparedness measure. Unlike automatic assembly systems for long-run, standardized operations, the GE system can adapt itself immediately to work on varied sizes of circuit boards, using different types and sizes of components with up to eight leads each.

The system has an electronic reader, which sets up production steps from punch cards. When a different job is to be done, the reader is fed the punch card for the job. It then sets up the system to prepare and test components, convey them to the assembly unit, assemble them, and test the completed sub-assembly.

The system can be programmed to place any number of components, limited only by the size of the circuit boards and the size of components to be placed. The G-E system can place 1,600 components per hour.

Magnetic Recording Group To Study Standardization

Four subcommittees to study standardization problems and recommend procedures to be adopted have been set up by the Standards and Engineering Committee of the Magnetic Recording Industries Association, which recently held its second annual meeting at the Hotel New Yorker, N.Y.

Specific standardization problems to be studied are the general order of procedure to be adopted in setting standards and cooperation with allied organizations; a preliminary survey of playback standards for all tape speeds; review of the status of dimensional specifications, tapes and reels; and investigating the preparation of standards on heads and track placements.

Association members who have been assigned chairmanship of these subcommittees are C. J. LeBel of Audio Devices Inc., Russell Tinkham of Ampex Electric Corp., Arnold Hultgren of American Molded Plastics Corp. and Clarence Sprosty of Brush Development.

Manpower Conference

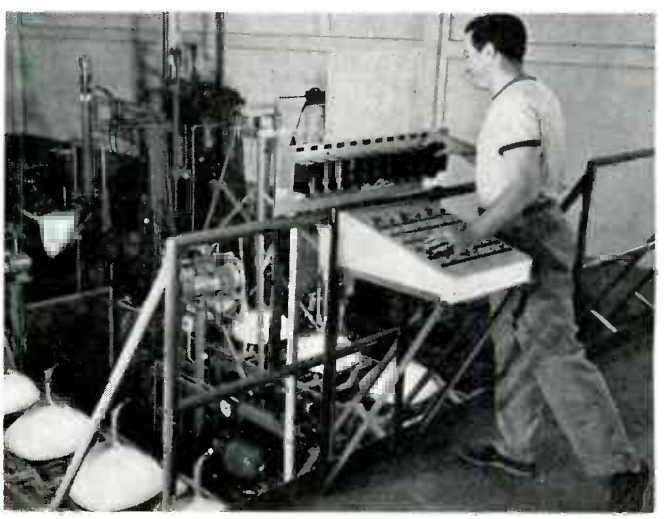
The Fourth Conference on Scientific Manpower, sponsored by the National Scientific Foundation, the National Research Council, the Engineering Manpower Commission, the Scientific Manpower Commission and Section M-Engineering of the American Association for the Advancement of Science, will be held in Berkeley, California, December 28-29, 1954.

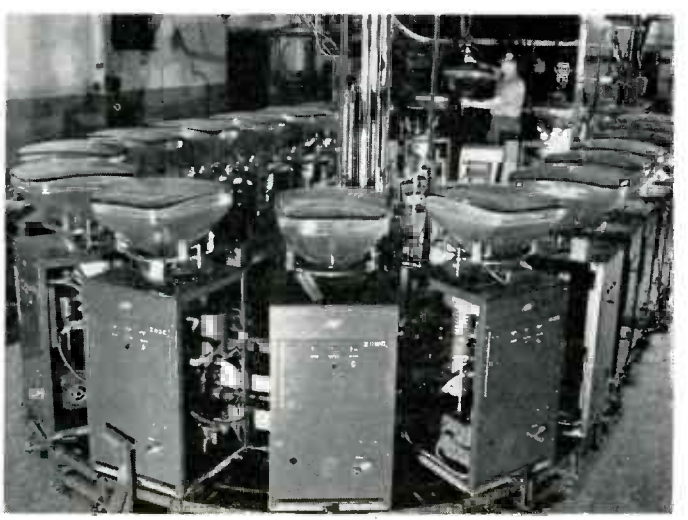
Minimum Gov't. Control of Broadcasting Expected

From the new FCC Chairman George C. McConnaughey comes the statement, "I believe in having as few government controls as possible. . . . The public interest is on the one hand served by the full force of private initiative and private investment, and on the other protected by alert government regulation which prevents abuse of private freedom." At about the same time, NARTB President Harold E. Fellows noted that "the time has come when the vast resources and strength of American business must be utilized in the defense of broadcasting as a free institution."

MORE NEWS on page 14

SYLVANIA EXPANDS SENECA FALLS PRODUCTION

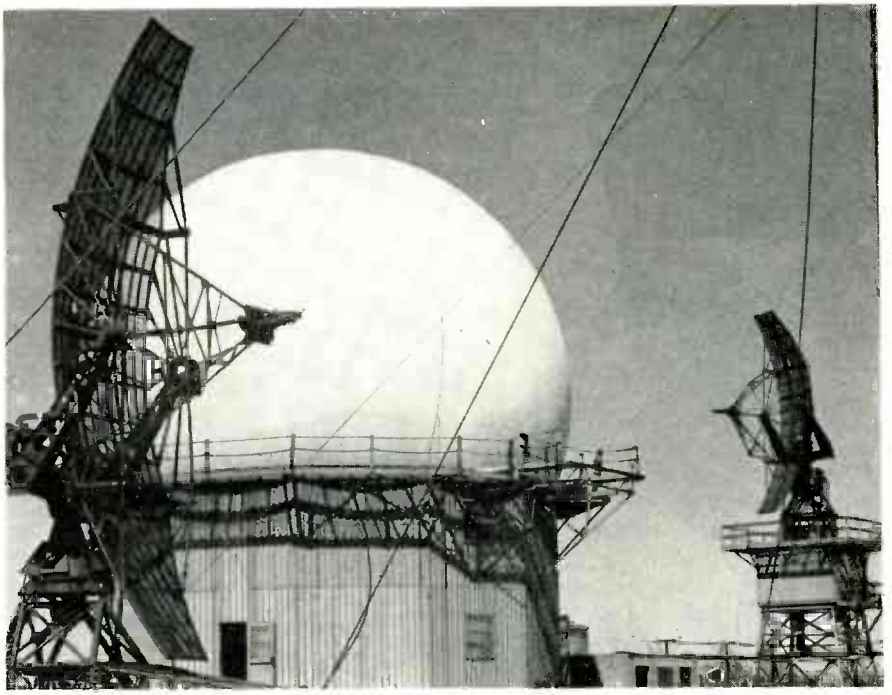




Completion of automatic aluminized TV picture tube facilities enables additional output of 25,000 more units per month. Photo at left shows new settling room under one man centralized control. At right new equipment for automatic in-line aluminizers are seen.

As We Go To Press . . . (Continued)

New Radar for Arctic Defense Net



Three versions of new radar height finder made for U.S. Air Force are (l) mobile unit, (c) radome for radar in Arctic climates, and (r) unit for fixed installations in temperate regions

A powerful new radar height-finder being made by the General Electric Co. for the U.S. Air Force is helping to strengthen defense networks of the United States and its allies. It is reported that the device can detect planes three times as far as previous units of this type. Exact range is classified. The radar height-finder is being used together with search radar to detect high-flying aircraft and to provide information on distance, altitude and flight direction.

In Arctic climates the radar is housed in a dome-shaped circular structure with a balloon-like radome made of woven glass fabric impregnated with a rubber compound. The radome is supported by air pressure, about a half pound per square inch, and can withstand winds up to 125 miles per hour. The radome protects the radar antenna from Arctic gales, snow and ice.

Inside radome building, radar height-finder has own room above control center. Air pressure supports rubberized glass fabric "balloon." Radome entrance is through air lock chamber

Engineers of the G.E. Heavy Military Electronic Equipment Dept. at Syracuse, and the Griffiss AFB at Rome, N.Y., collaborated in developing the radar.

FCC Reports TV Broadcast Figures

Initial investment in tangible TV broadcast property, as of the end of 1953, has been reported by the FCC to total $233,100,000. This includes equipment and property owned by 325 TV stations and four networks. The total investment accounts for $71,600,000 by networks and their 16 owned and operated stations; $87,400,000 by 91 pre-freeze stations; $40,900,000 by 109 post-freeze VHF stations; and $33,000,000 by 109 post-freeze UHF stations.

Time sales during 1953 by the networks and 260 stations were $384,000,000, or 36% above 1952. Of this amount, network time sales accounted for $171,000,000, or 25% above 1952; national spot sales $124,318,000, or 55% over 1952; and local sales $88,474,000, or 36% above 1952. Stations with less than $25,000 annual sales are not required to report their revenues or investment.

Mobilization Group Formed

A panel of leading engineers and scientists from industry, government and universities has been formed to study methods of mobilizing scientific resources in case of emergency. The group, headed by Dr. James R. Killian, Jr., President of MIT, will have their findings reviewed by the Office of Defense Mobilization, and recommendations will be submitted to the President.

New Calif. Hq for Sprague

The Sprague Electric Company has started construction of a 13,000 square foot, one story building in the Venice section of Los Angeles, Calif., to house all its Southern California operations. The building, in contemporary modern California architectural style of stone, glass, and cinder block, is expected to be completed in the spring of 1955. The Sprague company will then move from its present rented quarters in Culver City.

AF Aids RR

The spirit of Casey Jones flew into Virginia on an Air Force Mitchell B-25 and helped to unsnarl a railroad disrupted by the recent Hurricane Hazel. For the first time in railroading history, two Air Force officers and a Navy captain played aerial dispatcher.

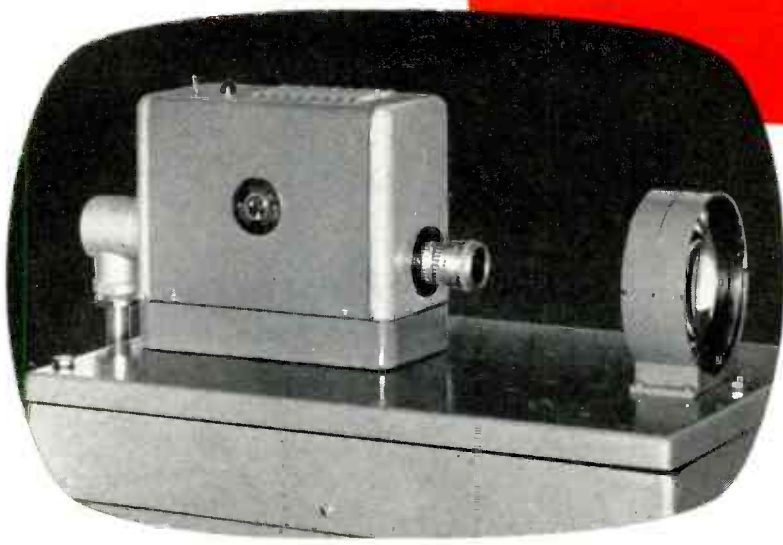
The officers, Maj. Frank B. Evans and Capt. James M. Dunn, USAF, and Capt. C. W. Rooney, USN, on a routine cross-country flight between Andrews AFB and the Naval air station at Key West, Fla., received a distress call from the Atlantic Coast Line R.R. via Richmond Radio in Va. Hurricane Hazel had broken railroad communications, fouled railroad signals and disrupted schedules. The Atlantic Coast Line had lost contact with its trains. Utilizing the B-25 as a relay point and the officers as stop-gap dispatchers, the railroad transmitted schedules from Richmond Radio to Rocky-mount, Va. Later, as the airplane continued south, Radio Danville added its voice to the impromptu communication system.

MORE NEWS on page 18

Your FILMS and COSTS BOTH LOOK BETTER

with the new

GPL VIDICON FILM CHAIN



- Low first cost; low operating cost
- Operates unattended; frees studio manpower
- Photo-conductive tube
- Stable black level
- No shading correction required
- No back or edge lighting required
- Lowest "noise" level in television
- Easy to multiplex

TWO MAJOR ADVANTAGES for station owners sum up the features of this new Vidicon Film Chain produced by GPL.

First, it sets a new high for quality.

Second, it saves dollars. And more dollars.

It's built around a photo-conductive tube, with long-proven GPL circuits and construction techniques. It is compact, simple and rugged . . . easy to maintain, flexible for 4 *or more* multiplex combinations. All your existing projectors, monitors, master monitor and standard racks can be used. *A stable black level, and almost complete absence of spurious signals, eliminates the need of constant attention. You save man-hours that previously went into monotonous monitoring.*

This GPL chain has the lowest noise level in television. The grey scale reproduction is true. In all, with this GPL combination of both quality and economy, you can afford to retire your iconoscopes to slides. And, in equipping a new station, the GPL Vidicon is unmatched for value.

STATION OWNERS & OPERATORS

Test this GPL chain in your station, with your projectors and monitors . . . your operating conditions. See for yourself its almost automatic operation, its quality with all types of film. No charge, no obligation. Just write, wire or phone.

General Precision Laboratory

INCORPORATED

PLEASANTVILLE NEW YORK

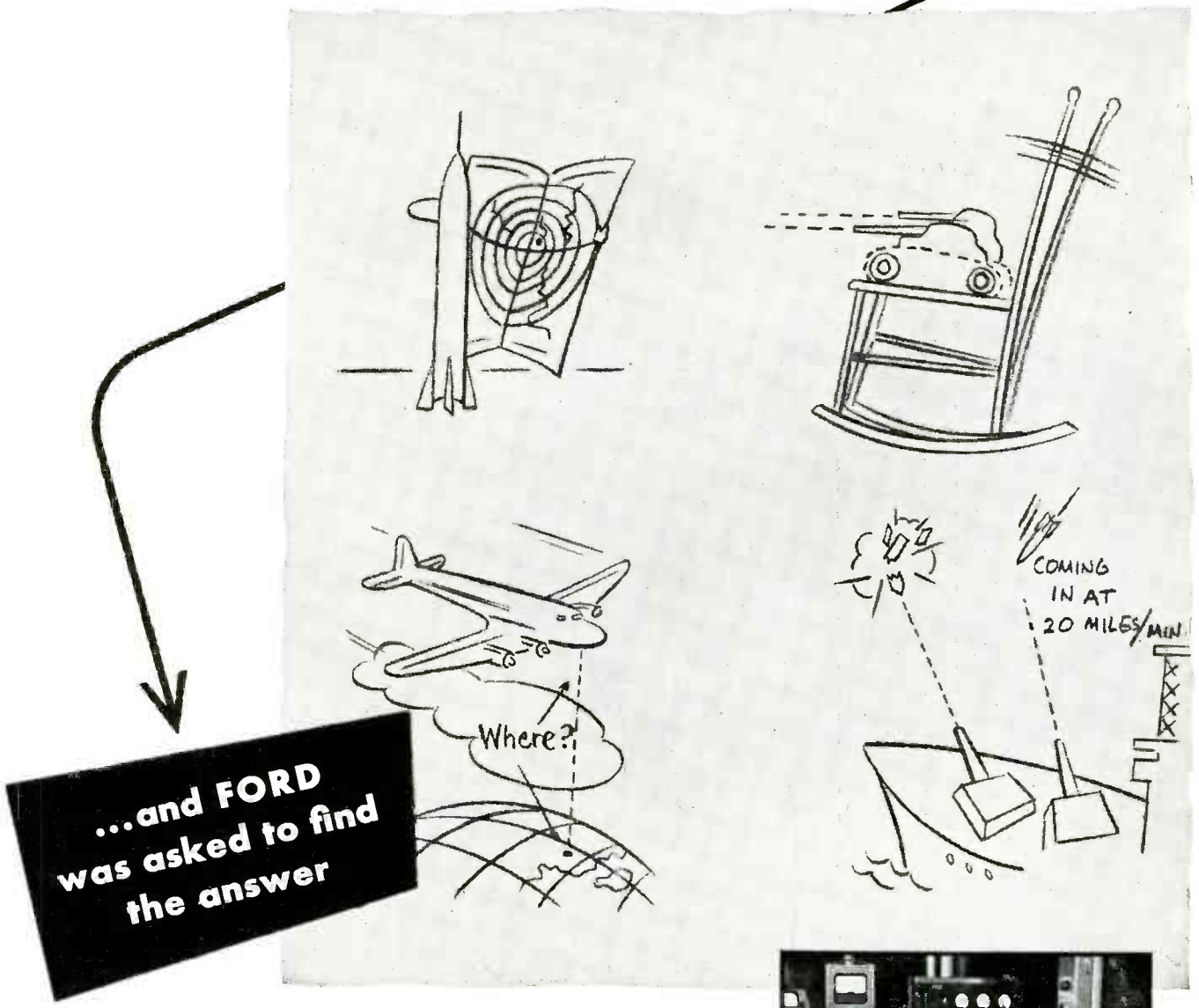
GPL

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

Write, wire or phone for information

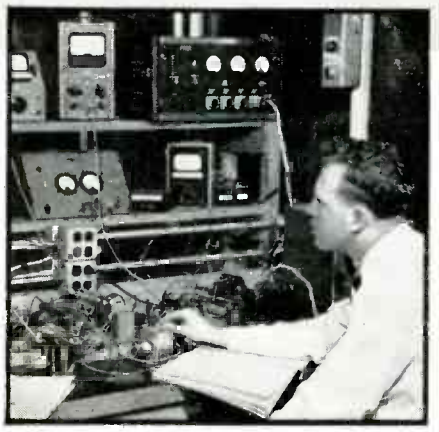
Regional Offices: Chicago • Atlanta • Dallas • Glendale, California

HOW CAN AUTOMATIC CONTROL
strengthen our defenses



MISSILE GUIDANCE . . . GUN STABILIZATION
AIRCRAFT NAVIGATION . . . WEAPONS SYSTEMS

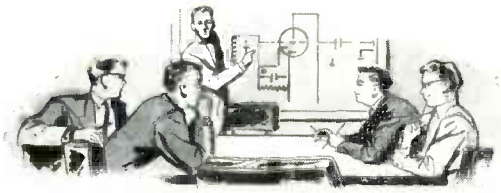
The staff of engineers at Ford Instrument Company are experts in the field of automatic control. Every week, in the laboratories and shops of this large company thousands of men are working on electronic, hydraulic, mechanical and electrical servo-mechanisms, computers, controls and drives to solve problems for the Army, Navy and Air Force. Ever since Hannibal C. Ford started, in 1915, to develop and build the first gunfire computer for the U.S. Navy, Ford Instrument has been leading the way in applying the science of automatic control to America's defensive strength . . . and to American industry.



Each year the Ford Instrument Company is adding to its staff of several hundred engineers. If you are an engineer and can qualify, there may be a position for you.

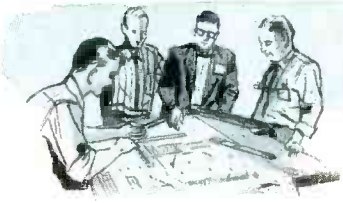
34

FORD INSTRUMENT COMPANY
DIVISION OF THE SPERRY CORPORATION
31-10 Thomson Avenue, Long Island City 1, N. Y.

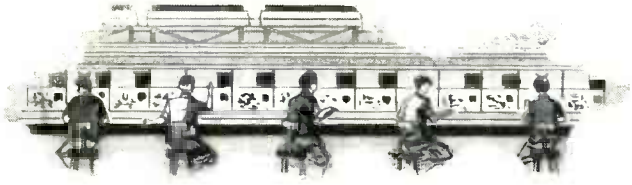


Research

Development



Design



Production

AN INTEGRATED ELECTRONICS OPERATION

Navigational Gear
Guided Missiles
Radar
Noise Rejection
Counter Measures
Computers
Communications
Terminal Equipment
Transistors

Hoffman's reputation for getting things done is due, in part, to the unification of Research-Development-Design-Production into one closely integrated electronics operation. At Hoffman – instead of the usual four completely separate operations – one technical director is assigned to co-ordinate each new project from start to finish. Every new project is developed in close cooperation with the divisions ahead, including the practical problems of quantity production. This integration practically eliminates the all-too-common duplications and overlapping of functions, the errors and re-work caused by poor liaison, and materially cuts down the usual time lag between the testing of the prototype and actual production. Hoffman has become a leader in electronics by doing progressively complex jobs – to specifications – to cost estimates – and on schedule.

Hoffman
LABORATORIES, INC.
A SUBSIDIARY OF HOFFMAN RADIO CORP.

Write for your copy of a
REPORT FROM HOFFMAN LABORATORIES

HOFFMAN LABORATORIES, INC.
A Subsidiary of Hoffman Radio Corp.
3761 South Hill Street, Los Angeles 7, California

Challenging opportunities for outstanding electronics and mechanical engineers. Write Director of Engineering.

As We Go to Press . . . .

Largest Delay Lines

The successful manufacture of the largest solid ultrasonic delay lines ever built is reported by Corning Glass Works, Corning, N. Y. Made of fused silica, the folded-path lines have a delay of 3,333 microseconds. Two of these 20-in. diameter delay lines were built for the Lincoln Laboratories at the M.I.T. They will be used in the development of prototype radar equipment.

Disk-like in appearance, each line consists of a thin polygon sheet of fused silica. The sheets were cut and ground by precision methods similar to those used in the preparation of optical glass to meet tolerances up to ±0.0003-in. After testing, the glass was mounted and cushioned inside an aluminum casing.

First Transistor Radios in Mass Production

The first commercial transistorized portable radio receiver to be mass produced for the general public has been announced by the Regency Div. of I.D.E.A. The unit features long battery life, measures 3 x 5 x 1¼ in., and retails for $49.95. The radio uses only four transistors of the grown-junction n-p-n germanium type, made by Texas Instruments. One of the low-cost transistors is used as a combination mixer-oscillator, two as i-f amplifiers with power gain of 34 db, and one as an audio amplifier with 40 db gain. One germanium diode detector is employed.

The radio, designated the TR-1, is a notable example of cooperation between several component manufacturers. Included are a small, efficient speaker made by Jensen Mfg. Co.; a tiny tuning capacitor produced by Radio Condenser Co.; a diminutive i-f transformer designed by Vokar Corp.; a miniature low-cost volume control created by Chicago Telephone Supply Corp.; a very small ceramic capacitor engineered by Centralab Div. of Globe Union; and a subminiature output transformer made by Texas Instruments. These and other tiny components are assembled into the completed radio in a semi-automatic process using printed wiring and dip soldering techniques.

MORE NEWS on page 21

COMING EVENTS

Nov. 29-Dec. 4—First International Automation Exposition, 242nd Coast Artillery Armory, New York, N. Y.

Dec. 7-9—3rd Annual Wire and Cable Symposium, sponsored by Army Signal Corps Engineering Labs, Ft. Monmouth, and Wire and Cable Industry, Berkeley-Carteret Hotel, Asbury Park, N.J.

Dec. 8-10—4th Annual Eastern Joint Computer Conference and Exhibition, jointly sponsored by the AIEE, IRE, and ACM. Bellevue-Stratford Hotel, Phila. Pa.

1955

Jan. 17-19—Conference on High Frequency Measurements, sponsored by IRE, AIEE, URSI and Nat'l Bur. of Standards, Hotel Statler and Dept. of Interior auditorium, Washington, D.C.

Jan. 20-21—Symposium on Printed Circuits, sponsored by RETMA, Univ. of Pa., auditorium, Philadelphia, Pa.

Jan. 24-26—Plant Maintenance & Engineering Conference, International Amphitheatre, Chicago, Ill.

Jan. 26-28—10th Symposium on Instrumentation for the Process Industries, sponsored by School of Engineering, Chemical Engineering Dept., Agricultural & Mechanical College of Texas, College Station, Texas.

Feb. 10-12—7th Annual Southwestern IRE Conference and Electronics Show, sponsored by Dallas-Fort Worth section of IRE, Baker Hotel, Dallas, Tex.

Feb. 11-13—Audio Fair-Los Angeles, sponsored by Los Angeles Section of AES, Alexandria Hotel, Los Angeles, Calif.

Feb. 17-18—Conference on Transistor Circuits, sponsored by IRE, professional Group on Circuit Theory, Science and Electronics Div. of AIEE, and Univ. of Pa., University of Pa., Philadelphia, Pa.

Mar. 14-18—ASTE Western Industrial Exposition and Annual Meeting, Shrine Auditorium and Exposition Hall, Los Angeles, Calif.

March 21-24—1955 IRE National Convention, Kingsbridge Armory, New York, N.Y.

Apr. 18-22—National Convention of Dept. of Audio-Visual Instruction of Nat'l. Education Assn., Hotel Biltmore, Los Angeles, Calif.

May 16-20—National Materials Handling Exposition, International Amphitheatre, Chicago, Ill.

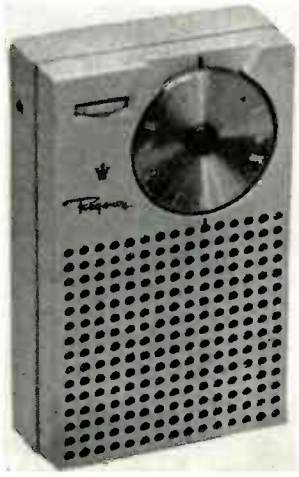
June 20-23—2nd International Powder Metallurgy Congress, Reutte, Tyrol, Austria.

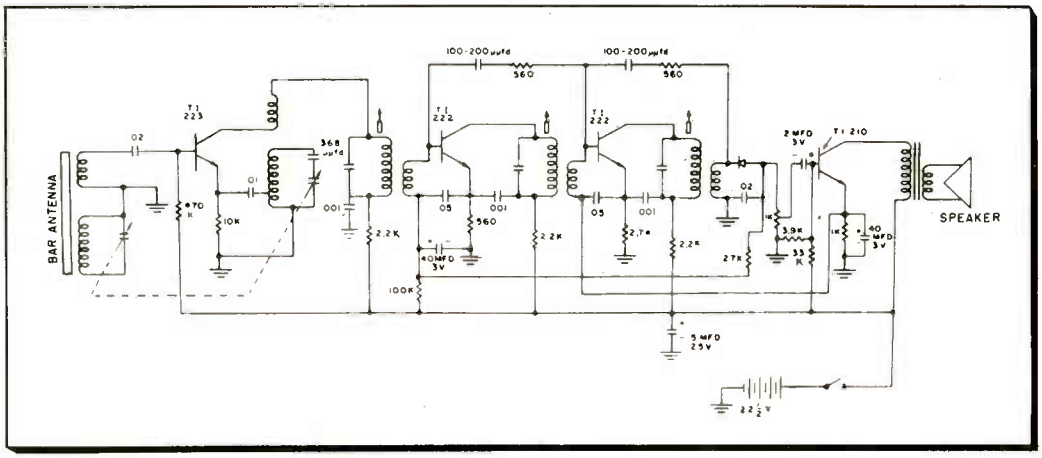
Aug. 24-26—Western Electronic Show & Convention, San Francisco Civic Auditorium, San Francisco, Calif.

Nov. 2-5—World Symposium on Applied Solar Energy, conducted under leadership of Stanford Research Institute, Phoenix, Arizona.

ACM: Assoc. for Computing Machines.
AES: Audio Engineering Society.
AIEE: American Institute of Electrical Engineers.
IRE: Institute of Radio Engineers.
ISA: Instrument Society of America.
NACE: National Assoc. Corrosion Engineers.
NARTB: National Assoc. of Radio and TV Broadcasters.
RETMA: Radio-Electronics-TV Manufacturers Assoc.
RTCM: Radio Technical Commission for Marine Services.
URSI: International Scientific Radio Union.

(l) New Regency portable radio employing four Texas Instruments grown junction germanium transistors. Unit measures 3x5x1¼.
(r) Receiver circuit shows one transistor used as mixer-oscillator, two as i-f amplifiers and one as audio amplifier. Detector is germanium diode





An Announcement

of the Utmost Importance to Engineers Doing Research and Design Work in the Entire Audio Frequency Range.

BURNELL

Burnell and Co., Inc.

is proud to announce the development of *an entirely new product*—

ROTOROID®

a Variable Toroidal Inductor (patent applied for)

ROTOROID will prove to be a valuable aid in the solution of many engineering problems – in research and design – and opens new possibilities for production which were previously impractical or impossible.

ROTOROID Now 4:1

- . . . is a continuously variable, stepless toroidal inductor which can provide a 3:1 range of maximum to minimum inductance in 180° rotation of a shaft.
- . . . employs no mechanical resistance contacts and is therefore free of noise and wear.
- . . . requires no DC saturating currents and thereby eliminates the need for circuitry.
- . . . is applicable over the entire audio range (from approximately 300 cps). ROTOROID is not limited to any stock value of nominal inductance. It is available in any value of inductance now available in regular toroids.
- . . . is hermetically sealed and is virtually vibration and shock-proof, can be chassis or panel mounted.

An outstanding feature of ROTOROID is that, at maximum inductance, it provides the full Q of the toroid it contains. Thus, the user is at once able to take advantage of the high Q characteristics of toroids while at the same time having available a variable inductor not previously available in a toroid.

Applications: Virtually unlimited. Just a few of the many possible uses of ROTOROID are:

- **Tunable Audio Oscillators**
- **Variable Z Devices**
- **Servo Systems**
- **Telemetering**
- **Adjustable Selective Networks**
- **Variable Phase Shift Networks**
- **Variable Filters**
- **Electro-Mechanical Control Systems**

Availability: Immediately available: ROTOROIDS VTI-A and VTI-B which are equivalent in electrical characteristics to Burnell toroids TC-16 and TC-3 in cases 2¼" in diameter, 2 1/16" long. Soon to be available: two miniature types, VTI-C and VTI-D, equivalent to Burnell toroids TCO and TC-6.

Write Department G for further information.

Now Available

Burnell & Co., Inc.

Yonkers 2, New York

PACIFIC DIVISION: 720 Mission Street, South Pasadena, California

FIRST IN TOROIDS AND RELATED NETWORKS

3 BIG REASONS

to check BURNELL first!

ROTOROIDS® A continuously variable, stepless toroidal inductor which can provide a 3:1 range of maximum to minimum inductance in 180° rotation of a shaft. Write for new brochure which gives complete technical data.

TOROIDS Combining the advantages of toroidal type winding with the molybdenum permalloy dust core and other specially selected materials, these toroids provide higher Q than any other structure. They also provide greater stability of inductance vs. temperature and level in a smaller space. Their self-shielding properties permit compact assemblies of coils with a minimum of deleterious effects. Supplied to an inductance accuracy of 1%. Available in standard, miniature and sub-miniature sizes. Also in a wide variety of finishes, including ***for the first time toroids molded in a new special material.***

TELEMETERING FILTERS
Band pass filters available for every channel ranging from 400 to 70,000 cycles for band width between 15 - 40%. Low pass filters available for operation in either unbalanced or balanced line, and range in cut off frequency from 6 up to 10,500 cycles. Also, miniaturized filters that do not sacrifice attenuation characteristics, save up to 80% space.

3 EXTRA REASONS TO CHECK BURNELL FIRST!

- ✻ Proven Top Quality
- ✻ Competitive Prices
- ✻ Prompt Deliveries

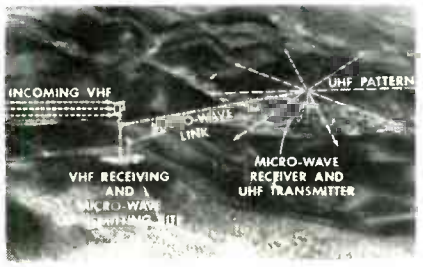
Write Department G for Catalog 102A

BURNELL & CO., INC.
Yonkers 2, New York

PACIFIC DIVISION: 720 Mission Street, South Pasadena, California

FIRST IN TOROIDS AND RELATED NETWORKS

As We Go to Press . . . .
SATELLITE TV



View at Emporium, Pa. shows Sylvania's satellite TV transmitting sites. Program on VHF channel 6, WJAC-TV, Johnstown, Pa., is microwaved to UHF station KG2XEL where it is retransmitted on Channel 82. Sylvania also operates KG2XDU, Channel 22, located at VHF receiving site. Both stations have output power of 10 watts (175 watts ERP) and are used in conducting research and development work designed to provide video reception in areas where good signals are blocked by mountains, hills or other natural obstacles.

Ampex Celebrates Tenth Anniversary

To commemorate the firm's 10th anniversary, executives of the Ampex Corp. presented a 10-year service pin to its founder and president, Alexander M. Poniatoff.

Ampex was founded November 1, 1944, by Mr. Poniatoff, as a manufacturer of precision, permanent-magnet motors and generators used in airborne radar scanning devices. With the end of World War II defense contracts were suddenly cancelled and the company found itself without a market for its products. A search for a suitable postwar product of commercial value ended when Poniatoff witnessed a demonstration of the Magnetophon, a German tape recorder. Poniatoff and his two leading engineers, Harold Lindsay and Myron J. Stolaroff, began development of the first Ampex recorder in April, 1947 and built the first machine by February, 1948.

Fate catapulted Ampex to the forefront of the magnetic recording industry in the form of Bing Crosby who was faced with the prospect of having to go to "live" broadcasting, because of a low Hooper rating attributed to "canned" characteristics of recording methods used in 1948. In his search for a recording medium that could not be distinguished from direct broadcasting, he arranged a series of demonstrations by manufacturers of the then "new" magnetic recording machines including Ampex. On hearing the Ampex, Crosby placed an order for the first 20 Ampexes at $4,000 each. These machines were later sold to ABC, and Bing Crosby Enterprises has been an important Ampex distributor ever since.

Years of experience

proves to users . . .

the dependability of

KOVAR*

Glass-sealing Alloy

* Westinghouse Trade Mark No. 337,962

The ideal alloy for glass sealing, Kovar matches the expansivity of certain hard glasses over the entire working temperature range. It resists mercury attack, has ample mechanical strength and seals readily. A permanent and impervious bond is obtained by a closely controlled thickness of oxide on Kovar alloy interfused with hard glass.

Kovar is a cobalt, nickel, iron alloy, manufactured under very carefully controlled conditions, and supplied by Stupakoff in the form of: SHEET, ROD, WIRE, FOIL, TUBING, EYELETS, LEADS and FABRICATED SHAPES. The prominent users of KOVAR and the length of time they have employed this metal are convincing proof of satisfaction.

Full information on the use of Kovar is given in Stupakoff Bulletin 145, which we will send upon request.

Stupakoff CERAMIC & MFG. CO.

Latrobe, Pennsylvania

18 YEARS

18 YEARS

Western Electric

16 YEARS

AMPEREX

12 YEARS

RCA

18 YEARS

Eimac

TUBES

13 YEARS

FEDERAL TELEPHONE & RADIO FTR

11 YEARS

MACHLETT

15 YEARS

Bomac

6 YEARS

WESTINGHOUSE

18 YEARS

VARIAN associates

5 YEARS

RAYTHEON

18 YEARS

7 YEARS

SPERRY

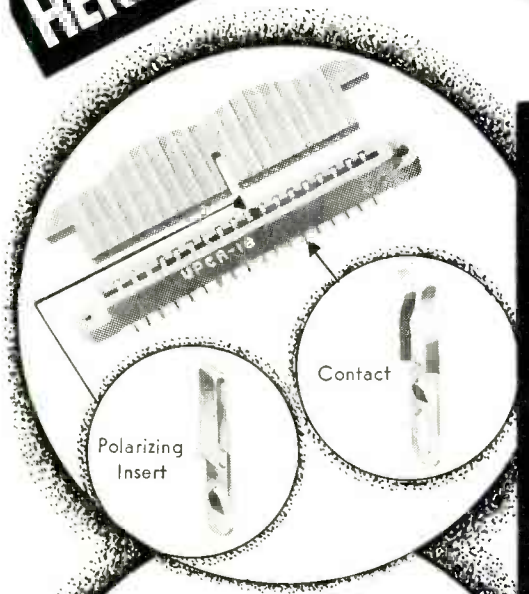
13 YEARS

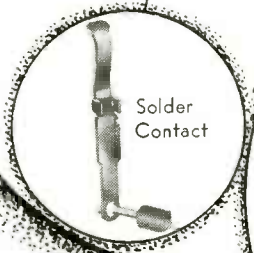
HERE'S WHY U.S.C. PRINTED CARD RECEPTACLES* ARE SPECIFIED FOR MODERN DESIGN

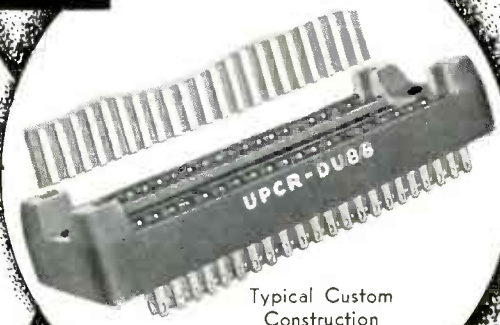
CHANNEL STRENGTH CONTACTS
•
SNAP-IN CONTACT CONSTRUCTION
•
FATIGUE PROOF
•
EASY CARD INSERTION
•
PROPER CONTACT RETENTION FORCES
•
WIDE TOLERANCE RANGE CARD OPERATION
•
RUGGED-COMPACT-LIGHTWEIGHT

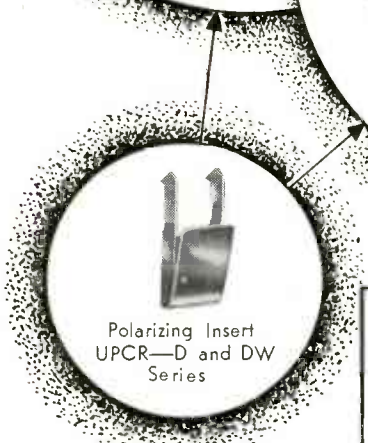
U. S. C. offers a Complete Repertory of Printed Card Receptacles to meet the ever increasing requirements of Modern Applications. Illustrated on this page are a few of the U. S. C. Receptacle versions that have found wide acceptance by leading engineers. U. S. C. is constantly co-operating with Industry in designing and developing new types in various configurations. You will find the solution to your connector problems at U. S. C.

Over a thousand different types of connectors are now manufactured by U. S. C.









* Patents Pending

AVAILABILITY

Insulating body available in Mineral Filled Melamine, Alkyd 440 A and Diallyl Phthalate
Contacts — Phosphor Bronze and Beryllium Copper — Silver plated with Gold Flash

For 1/16" boards (range .052 — .072)
UPCR—6, 10, 15, 18, and 22
For 1/16" boards — Double Row Wire Solder –
UPCR—DW6, 10, 15, 18, and 22
For 1/16" boards — Double Row Wire Wrap –
UPCR—DW6, 10, 15, 18, and 22
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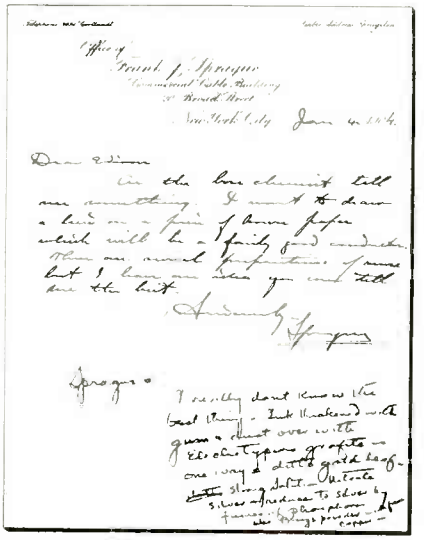
For 3/32" boards — Double Row Wire Wrap –
UPCR—93DW6, 10, 15, 18, and 22
other designs to specifications

U. S. COMPONENTS, Inc.
Associated with U. S. Tool and Mfg. Co., Inc.
454-462 East 148th Street, New York 55, N. Y. CYpress 2-6525-6

TELE-TIPS

PRINTED CIRCUITS—1904 STYLE: The letter reproduced below, written by Frank J. Sprague to Thomas A. Edison, is dated Jan. 4, 1904. It provides some interesting historical insight into the thinking of leading scientists more than 50 years ago.



The text reads:

Dear Edison:

As the boss chemist—tell me something. I want to draw a line on a piece of brown paper which will be a fairly good conductor. There are several preparations—of course—but I have an idea you can tell me the best.

Sincerely,
Sprague

Sprague—

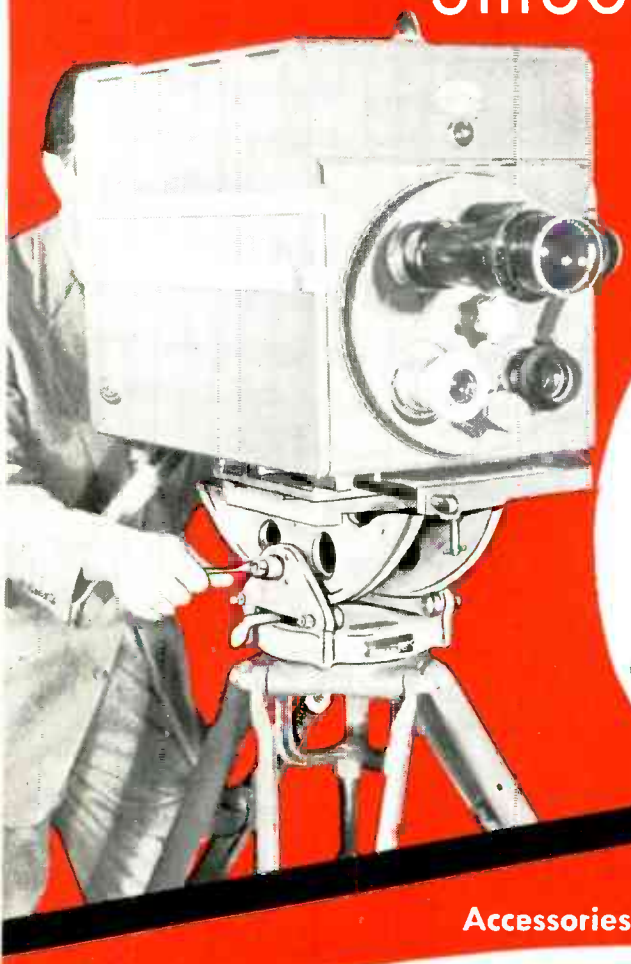
I really don't know the best thing. Ink thickened with gum & dust over with electrotypers grafite is one way—ditto gold leaf—strong solution nitrate silver & reduce to silver by fumes of phosphorus. Also bronze powder made from copper.

"TOM THUMB" rocket fuze developed by Elgin National Watch Co. is about 1/10 the size of the mechanical time fuze which was considered a miracle of miniaturization a decade ago. According to the firm's president, J. G. Shennan, the World War II variety are fast becoming museum pieces.

SAFETY GLASS in TV receivers is no better than the mountings that hold it. In a recent case, the picture tube imploded, blowing the still-intact protective window right out of

(*Continued on page 28*)

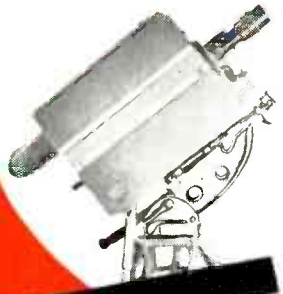
Smooth, Smoother, S-m-o-o-t-h-e-s-t



TV camera action ever known with

CAMERA EQUIPMENT

GRAVITY BALANCED ROCKER TYPE PAN AND TILT HEAD



You'll know what we're talking about the instant you try it! Our new ROCKER Head has almost gyroscopic action, smooth, effortless. No longer do you have to fight spring balance to make your tilts.

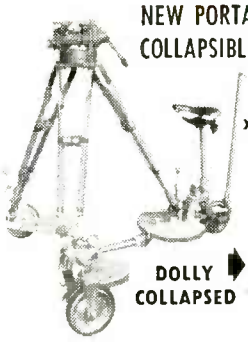
You establish absolute balance by positioning camera on ROCKER head platform and adjusting center of gravity with vernier control. Long and short lenses are compensated for with vernier adjustment. Prompting device may be added and balanced easily. Convenient brake handles and locking device for pan and tilt tension. Fits standard tripod and dollies. Lighter in weight—and more economical in price. See it—test it—it's a "must"!

Accessories that SURPASS accepted standards— for Studio, Mobile and Micro-Relay Equipment

New Model C BALANCED TV Head provides correct center of gravity in a FLASH— without groping. No matter what focal length lens is used on the turret, the camera may be balanced by the positioning handle without loosening the camera tie-down screw. Something every camera-man has always desired.

NEW PORTABLE 3-WHEEL COLLAPSIBLE DOLLY

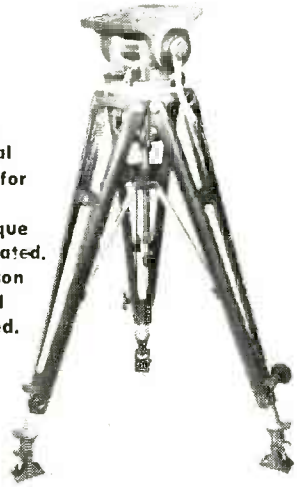
Dolly folds to fit into carrying case—18"x12" x36". Weighs only 60 lbs. Has wheel in rear for steering, which may be locked for straight dollying.



DOLLY COLLAPSED ➡

MICRO RELAY

Micro wave relay beam reflector head, also metal tripod. Head is perfect for parabolas up to 6 ft. diameter, withstands torque spec's environmental treated. Tripod legs work in unison one lock knob, spurs and rubber foot pads included.



Famous BALANCED TV Head supporting a TV camera. Both are mounted on one of our all-metal tripods, which in turn is mounted on a Ceco Spider Dolly. Here is a "team" outstanding for versatility and maneuverability in studio or on location.

WRITE FOR COMPLETE ILLUSTRATED BROCHURE

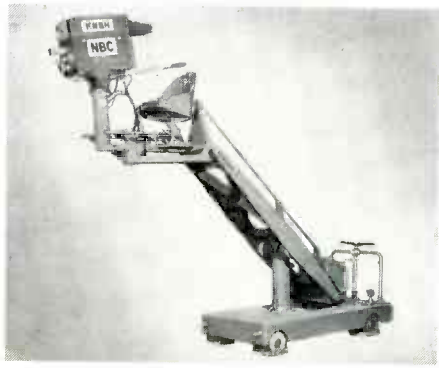
FRANK C. ZUCKER

CAMERA EQUIPMENT CO., INC.

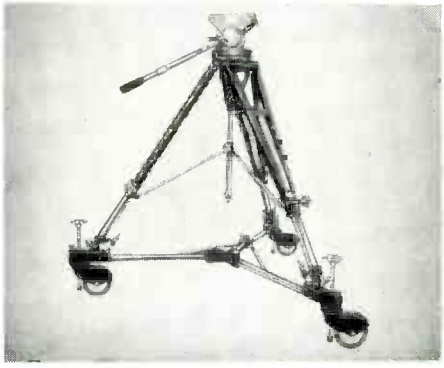
Dept. T-1215 • 1600 Broadway • New York City

PANORAM DOLLY gives camera complete mobility; smooth panning, dolly shots, running shots, special effects. Two man crew.

CINEMOBILE offers extreme maneuverability. Camera boom raises hydraulically. Ideal for smooth dollying, panning, etc. Two man crew.



HOUSTON-FEARLESS TC-1 CRANE raises camera to extremely high and low positions. Permits "fluid motion" shots. Foot-operated panning.



HOUSTON-FEARLESS All-Metal Tripod on Tripod Dolly gives mobility to cameras at low cost. Completely portable. Ideal for remotes.

CAMERA is counterbalanced in Model PD-3 TV Pedestal by Houston-Fearless, enabling cameraman to raise or lower with ease.

WHICH TYPE OF CAMERA MOUNT SHOULD YOU BUY?

Proper mounting of television and motion picture cameras is essential for efficient operation, smooth production and good showmanship. Choice of mobile equipment should be determined by the size of your studio, types of shows, size of camera crew, camera equipment used, budget and many other factors.

Each piece of Houston-Fearless equipment shown here has been designed for a specific purpose. Each is the finest of its type, the standard of the industry.

A Houston-Fearless representative will be happy to analyze your requirements and recommend the equipment that will serve you best. Write or phone: The Houston-Fearless Corp., 11801 West Olympic Boulevard, Los Angeles 64, California. BRadshaw 2-4331. 620 Fifth Avenue, New York 20, N. Y. CIrcle 7-2976.

MODEL BT-1 CRANE has power drive, hydraulic lift. Provides lens height from 2′ to 10′. Developed for Motion Picture Research Council.

TV PEDESTAL MODEL PD-1 by Houston-Fearless is operated by cameraman. Rolls smoothly, raises, lowers, turns on own radius.

When pennies make production sense...

Check your hermetic seal problems with standard E-I

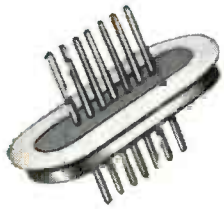
MINIATURE CLOSURES & TERMINALS*

*PATENT PENDING
ALL RIGHTS RESERVED

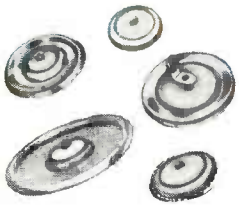
TWO ELECTRODE TERMINAL FOR MINIATURE ASSEMBLIES (SUPPLIED WITH CASE)

MINIATURE THREE ELECTRODE COMPONENTS (AVAILABLE WITH CASE)

SINGLE WIRE COMPRESSION TYPE MINIATURE SEALED TERMINALS

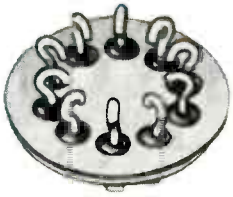


HERMETICALLY SEALED TERMINAL WITH CUSHIONED GLASS CONSTRUCTION

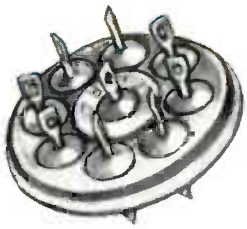


COMPLETELY STRAIN-FREE END SEALS FOR CONDENSERS RESISTORS, TUBULAR ASSEMBLIES

OCTAL HEADERS WITH SOLID METAL BLANKS FOR MAXIMUM RIGIDITY AND MECHANICAL STRENGTH



SUPER DURABLE COMPRESSION TYPE HEADERS OFFER MAXIMUM RESISTANCE TO SHOCK AND VIBRATION



SILICONE TREATED, STRAIN-FREE, VACUUM TIGHT MULTIPLE HEADER

LUG TYPE, LEAD THRU INSULATORS FOR VOLTAGE RATINGS FROM 2,000 TO 4,000 (rms.)

E-I Standard Types.— Samples and quotations on standard terminals and closures will be supplied promptly on request.

Require Custom Types? Special components for unusual requirements can be supplied quickly and economically in reasonable quantities.

Catalogs Available— Including specifications, diagrams and optional features. Call or write for copies, today!

MEMO

E-I...Headquarters for Multiple Headers, Sealed Terminals, Octal Headers, End Seals, Compression Type Headers, Lug-Type Lead-thru Insulators, Miniature Closures, etc.

DIVISION OF AMPEREX ELECTRONIC CORP.

ELECTRICAL INDUSTRIES

44 SUMMER AVENUE, NEWARK 4, NEW JERSEY

TELE-TIPS

(*Continued from page* 24)

the cabinet. Luckily, no one was within range of the glass shrapnel. Obvious moral: make stronger mountings.

AUTOMATIC TOLL COLLECTORS are being installed on New Jersey's Garden State Parkway. Coin transactions made by the highway robots are recorded on a tape recorder located in the administration building. Any attempts to beat the toll collector by not paying or short changing sets off an alarm, and other toll collectors (humans, that is) can radio police patrol cars to pick up the deadbeat.

RUSSIAN TV, according to some optimistic reports out of that country, includes nine stations and 700,000 receivers in use. The official newspaper, *Izvestia,* is complaining that a shortage of coax has prevented inter-city network connection, and an irresponsible approach to receiver design has seriously delayed large screen TV sets.

SELENIUM RECTIFIERS which show no indication of failure or decrease in output after more than 1000 hours at 150° C are being built experimentally by Bradley Labs., New Haven, Conn.

PSYCHIATRIST friend of ours claims that President Eisenhower's public slip-of-the-lip in calling RCA president Frank Folsom, "Mr. Stanton" (CBS president), was a "Freudian slip with deeper significance." What significance? Impossible to tell unless Ike becomes a patient.

ELECTROSTATIC SPEAKERS, which are becoming increasingly popular because of their ability to reproduce high frequencies, were introduced many years ago, but were driven off the market by the electrodynamic type. Reasons for early failure, reports A. A. Janszen, include susceptibility to electrical breakdown, low efficiency, oxidation of structural materials, and lack of manageable thin membrane materials.

MORE SHAKESPEARE, and for the benefit of the literati, the quotation's source.

HIGH ANTENNAS: *Those that stand high have many blasts to shake them.* (King Richard III)

(*Continued on page* 36)

color tv controls

CHICAGO TELEPHONE SUPPLY
Corporation

ELKHART • INDIANA

Specialists in Precision Mass Production of Variable Resistors • Founded 1896

THE ONLY COMPLETE LINE FOR ALL COLOR TV APPLICATIONS

1. SIZES—"dime size" to 2 1/2" diameter.
2. WATTAGES—2/10 watt to 4 watt.
3. TYPES—carbon and wirewound with and without attached switch.
4. MOUNTINGS—conventional bushing, twist ear and snap-in bracket for printed circuits.
5. TERMINAL STYLES—for conventional soldering, printed circuits and wire wrap.
6. COMBINATIONS—an endless variety of tandems, both single and dual shaft.

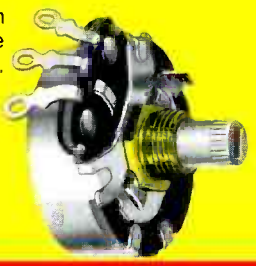
A CTS control can be tailored to your specific requirement.

FURTHER DETAILS ON OTHER SIDE

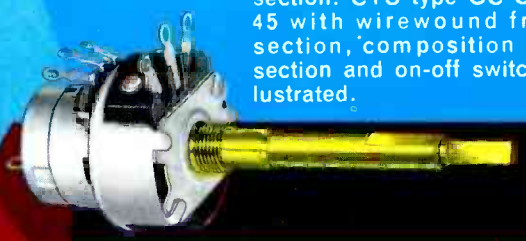
High voltage control for focus applications. Rated up to 5,000 volts DC across end terminals and 2 1/2 watts depending on total resistance. Will operate up to 15,000 volts DC above ground when mounted on insulated panel. CTS type 85.

Miniature 3/4" "dime size" composition control. Conserves panel space at price comparable to larger size bushing mounted controls. CTS type 70.

1 1/8" diameter composition control for applications where ratings up to 3/4 watt required. CTS type 35.



Concentric shaft tandem control with conventional bushing mounting. Designed for front panel dual knob applications, such as contrast and volume. Available in various combinations of composition or wirewound front and rear sections with or without on-off switch attached to rear section. CTS type GC-C252-45 with wirewound front section, composition rear section and on-off switch illustrated.



Ear mounted composition control. Simply twist two ears for rigid mounting. Eliminates bushing and mounting hardware. Available with shafts for knob operation or for preset applications with insulated or metal shaft. CTS type P45 with metal shaft illustrated.

Ear mounted two watt wirewound available with or without center tap. CTS type P-254 with tap illustrated.

Four watt wirewound control available with or without center tap. CTS type 27 with tap illustrated.

Higher Wattage Carbon Controls With Exceptional Stability Available

- **ONE WATT**: Entire 45 series 15/16" diameter line available with 90 series special one watt military resistance elements.
- **TWO WATT**: Entire 35 series 1 1/8" diameter line available with 95 series special two watt military resistance elements.

Ear mounted tandem for preset applications. Combines panel space saving features of a concentric tandem with the economy of an ear mounted unit. Available in various combinations of composition or wirewound front and rear sections. CTS type P-C2-45 with composition front and rear sections illustrated.

THE ONLY COMPLETE LINE FOR ALL COLOR TV APPLICATIONS

CTS also makes a complete line of controls for military, black and white TV, radio and other commercial applications. Consultation without obligation available for **all** your control applications. Write for complete catalog TODAY.

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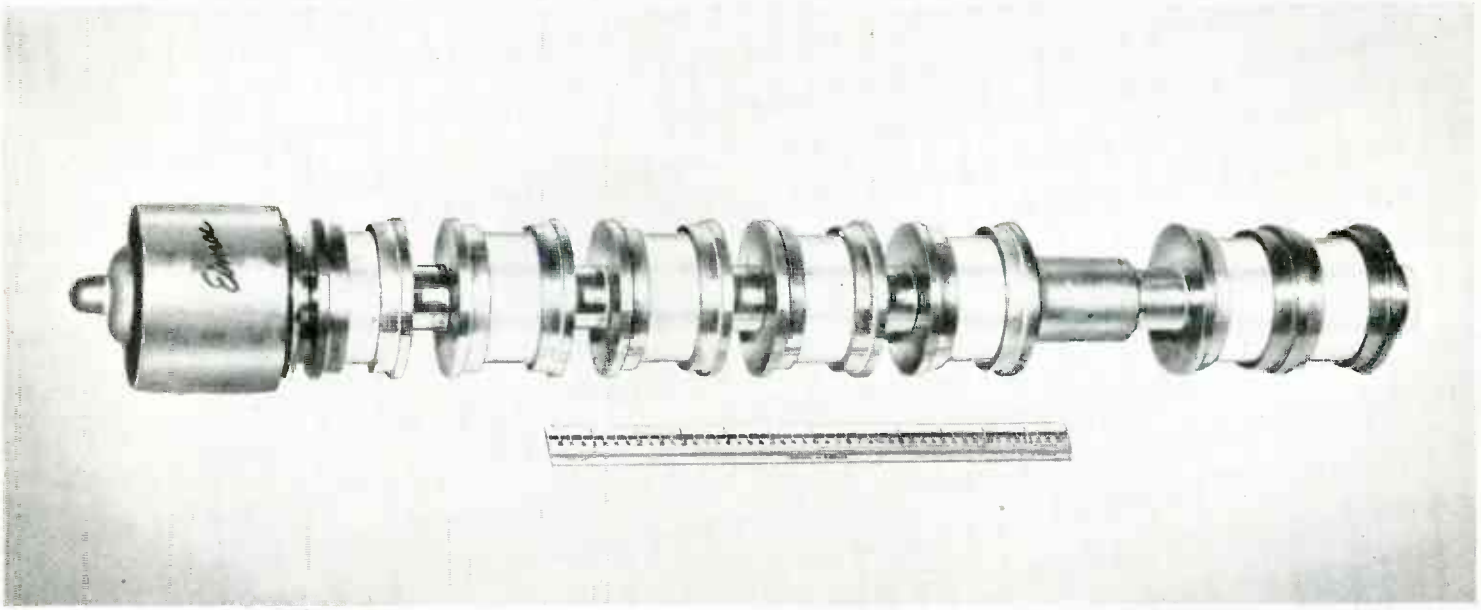
Eimac Klystron Report

X566

20kw modulating anode pulse klystron

- High power gain of 53db
- UHF operation — 960-1400mc



EIMAC X566 UHF klystrons have consistently obtained peak pulse power outputs of more than 20kw with over 40% efficiency at 960-1400mc. Many times more powerful than any other tube intended for similar operation, such as aircraft navigational aid Distance Measuring Equipment, the air-cooled X566 requires only 100 milliwatts driving power for a 20kw output — a power gain of 53db with bandwidth adequate for most pulse applications. Of special significance is the high average power capability of one kilowatt, allowing the duty cycle to be raised to 5% with a 20kw peak output, or 10% with 10kw output, and so on. Outstanding pulse capabilities of the X566 are made possible through the use of the Eimac modulating anode — an insulated anode between the cathode and drift tube section — permitting the klystron to be pulse modulated with low pulsing power. In Eimac high power amplifier klystrons using ceramic and copper construction, the resonant cavities are completed outside the vacuum system, which is left free of RF tuning devices — permitting easy wide range tuning and uncomplicated input and output coupling adjustment. This simplicity of design and rugged construction minimize replacement costs as well as making the Eimac X566 suitable for mass production techniques.

The X566, another Eimac high power klystron achievement, is now available with circuit components for experimental purposes.

- *For additional information, contact our Technical Services Department.*

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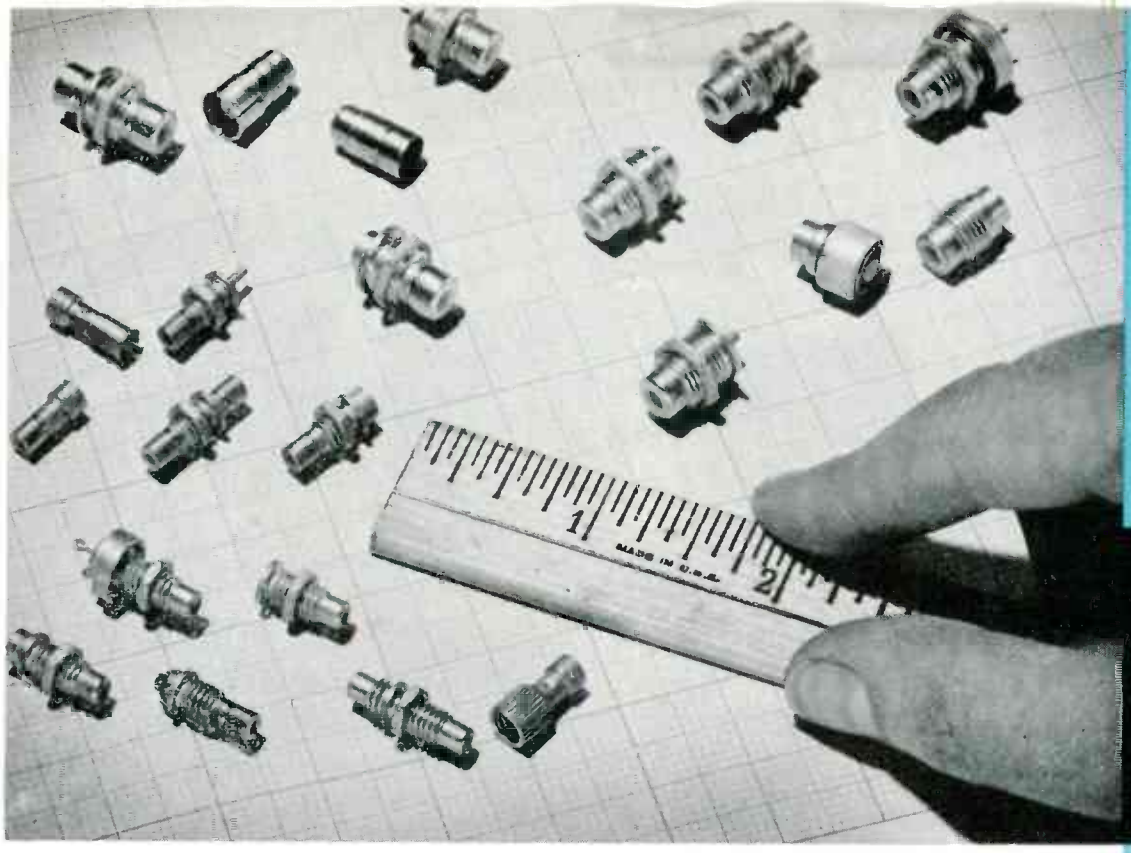
Eimac
THE WORLD'S LARGEST MANUFACTURER OF TRANSMITTING TUBES



connectors are actual size

complete listing of
SPACE-SAVING
SUBMINAX
RF CONNECTORS

the ruler tells the story...

AMPHENOL SUBMINAX RF CONNECTORS

A complete line of 50 and 75 ohm RF connectors, so small that all of the twenty-two connectors in the series easily fit in the palm of your hand!—the ruler certainly tells the story of the amazing new AMPHENOL ***subminax*** RF connectors! A result of the continuing AMPHENOL development work in the field of miniaturization, the new ***subminax*** connectors have all the dependable features of their older, larger brothers compressed into a fraction of the space usually demanded in RF connectors!

The ***subminax*** line is exceptionally complete. Connectors are available in both screw-on and push-on types in either 50 or 75 ohms. In each design there is a plug, jack, receptacle, jack bulkhead and feed through. In addition, *hermetically sealed* receptacles are available in the 50 ohm and 75 ohm screw-on connectors. Construction? ***Subminax*** connectors have machined brass bodies with a tough and shining gold-plated finish.

Although ***subminax*** cable assemblies are available directly from AMPHENOL, assembly at your plant is both easy and practical. Inexpensive and easy-to-use *hand crimpers* are available along with the necessary lengths of AMPHENOL Miniature Coaxial Cable.

50 ohm Push-on

Part No.	Description
27-1	Plug
27-2	Jack
27-3	Receptacle
27-4	Jack Bulkhead
27-5	Feed Through

50 ohm Screw-on

Part No.	Description
27-5	Plug
27-8	Jack
27-9	Receptacle
27-10	Jack Bulkhead
27-11	Feed Through
27-12	Receptacle, Hermetically Sealed

75 ohm Push-on

Part No.	Description
27-13	Plug
27-14	Jack
27-15	Receptacle
27-16	Jack Bulkhead
27-17	Feed Through

75 ohm Screw-on

Part No.	Description
27-19	Plug
27-20	Jack
27-21	Receptacle
27-22	Jack Bulkhead
27-23	Feed Through
27-24	Receptacle, Hermetically Sealed

MINIATURE COAXIAL CABLE

Three types of miniature coaxial cable are available from AMPHENOL for making *subminax* assemblies. These are 50 ohm and 75 ohm polyethylene dielectric with black vinyl jacket cable and a 50 ohm Kel-F dielectric and Kel-F jacket cable.

Part No.	RG-/U No.	Impedance	Description
21-596	—	50 ohm	Kel-F
21-597	—	75 ohm	Poly.
21-598	174	50 ohm	Poly.

AMERICAN PHENOLIC CORPORATION
chicago 50, Illinois
In Canada: AMPHENOL CANADA LTD., *Toronto*

depend on
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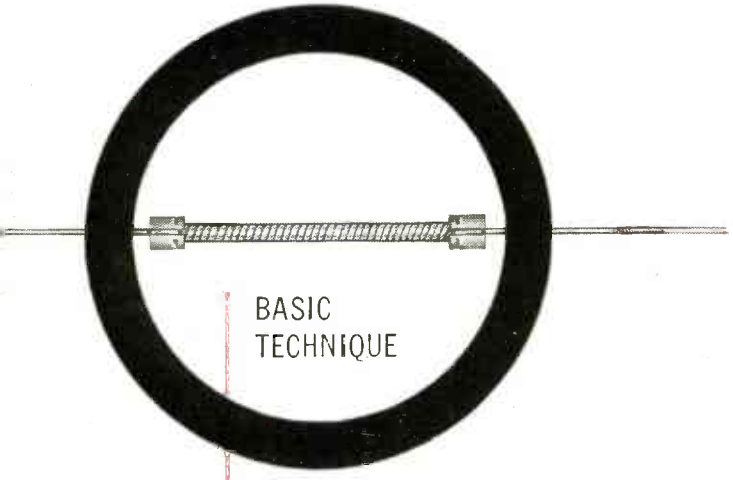
for progress!

Precision, high-speed winding equipment for IRC elements

ONLY IRC WINDING SKILL OFFERS



Wire element is uniformly and tightly wound on an insulated core. Axial leads or other terminations are secured to element by automatic machinery. Insulated housing may be used or omitted.

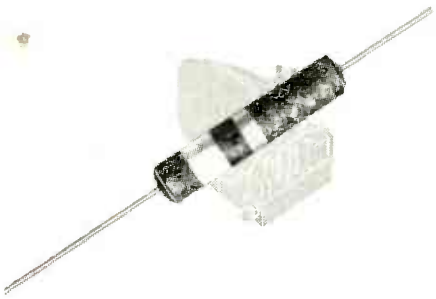
If you seek savings in component costs, IRC's winding skill may serve your need. IRC's mastery of winding wire elements dates back more than 25 years. Today, it provides a wide variety of unique units that offer realistic possibilities for savings. Cost-conscious IRC engineers will glady analyze your requirements.

14c savings per car

Type AW Wire Wound resistors save automobile manufacturers an average of 14c per car. For quantity requirements, these low-cost windings can be made specially to suit individual designs. This adaptability has proved profitable to numerous appliance manufacturers.

low cost—low wattage

Type BW insulated wire wounds offer excellent stability in low ranges—at low prices. Leading instrument manufacturers attest to their superiority. ½, 1 and 2 watt sizes are equivalent to Jan types RU-3, RU-4 and RU-6.



50% savings

IRC Insulated Chokes offer savings up to 50% over ordinary types. Available in two sizes, they are fully protected against humidity, abrasion, assembly damage and danger of shorting to chassis. A favorite source of savings for TV and radio set manufacturers.

THESE SAVINGS

inexpensive solution

4-watt Insulated Power Wire Wounds with axial leads can save several cents over conventional power resistors. Inorganic core and high-temperature plastic housing allow safe operation up to 165° C. Widely used in toys, juke boxes and amusement devices.

NEW *encapsulated* precision resistors

Type WW15M—MIL-R-93A Style RB15

Type WW16M—MIL-R-93A Style RB16

Type WW17M—MIL-R-93A Style RB17

Type WW18M—MIL-R-93A Style RB18

Type WW19M—MIL-R-93A Style RB19

- **Epoxy Resin Compound Used For Both Winding Form and Seal.**
- **Exclusive Molding Process Avoids Air Pockets And Assures Uniform Distribution Of Resin.**
- **Exceed MIL-R-93A Specifications In 1%, 0.5%, 0.25%, 0.1% Tolerances.**

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In Canada: International Resistance Co., Ltd., Toronto, Licensee

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Name_____

Title_____

Company_____

Address_____

City_____ State_____

TELE-TIPS

(*Continued from page 28*)

PIX TUBE IMPLOSION: *Is't possible that so short a time can alter the condition of a man?* (Coriolanus)

NEW COMPUTER: *He shall have a noble memory.* (Coriolanus)

TV AUDIO FAILURE: *She speaks, yet she says nothing.* (Romeo & Juliet)

STOCK SPECULATION: *A fool's paradise.* (Romeo & Juliet)

ALIBI: *The excuse that thou dost make in this delay is longer than the tale thou dost excuse.* (Romeo & Juliet)

TRACKING OF GUIDED MISSILES to be aided soon by three powerful optical tracking devices being made by Perkin-Elmer Corp., Norwalk, Conn. Instruments will consist basically of telescopes similar to those employed for astronomical observations but will incorporate rapid sighting properties of modern gun mounts.

TITANIUM PRODUCTION at sharply reduced prices may soon be in the offing because of a new powder metallurgy process according to Dr. Paul A Schwartzkopf, president of the American Electro Metal Corp., 320 Yonkers Ave., Yonkers, N. Y. The product derived from titanium scrap may inaugurate a way to drop prices from $15. a pound to less than one fifth.

BUILD YOUR OWN ELECTRONIC ORGAN—A new "home" model organ has been added to build-it-yourself kit line that Electronic Organ Arts, Box 41084, Los Angeles, Calif. is offering. Designed as a compact console it should appeal to home owners having only limited space available.

HEATING AND AGING have a marked effect on the stability of polystyrene dielectric capacitors. So reports the Condenser Products Co., division of the New Haven Clock and Watch Co., New Haven, Conn., who also claim that their capacitors which have undergone a heat and aging series during manufacture have less than 1.5% overall capacity change in temperature range of —60° C. to 85° C. Formerly this temperature coefficient was about 2%.

(*Continued on page 40*)

For long life under extreme conditions of shock, vibration, corrosion, humidity and temperature

Bendix W type HEAVY-DUTY ELECTRICAL CONNECTOR

Here is the electrical connector designed and built for maximum performance under rugged operating conditions.

Intended for use with jacketed cable and not requiring ground return through mating surfaces, this connector incorporates sealing gaskets at all mating joints.

W-Type Bendix* Connectors also incorporate standard Scinflex resilient inserts in established AN contact arrangements. Shell components are thick-sectioned high-grade aluminum for maximum strength. All aluminum surfaces are grey anodized for protection against corrosion.

For the real tough jobs, be sure to specify the W-Type Electrical Connector. Our Sales Department will gladly furnish complete specifications and details on request.

*TRADE-MARK

SCINTILLA DIVISION

Bendix AVIATION CORPORATION

SIDNEY, NEW YORK

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NEW!

VIDICON

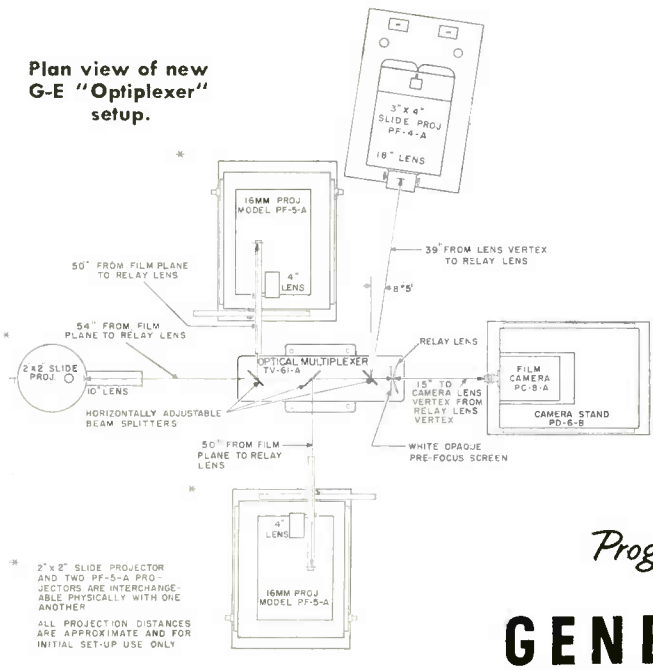
FILM CAMERA CHANNEL

HIGHEST FILM PROGRAMMING QUALITY TO TOP COMPETITION . . . BUILD SPONSORED TIME

YOUR STATION AUDIENCE will be vitally aware of the *quality difference* between G-E Vidicon film reproduced pictures and any other system. Only a keen eye can distinguish this from *live program reproduction.* And, it has many more benefits you'll recognize. First, since shading controls and the need for them have been eliminated, your operators can devote full time to other video duties. Next, this highly flexible film technique accommodates a variety of projected-image systems. There's a choice of channel amplifier mounting—either in a standard rack or in the camera stand.

Examine each stand-out feature of the G-E Vidicon Film Camera Channel and you'll decide here is the only channel that lives up to modern day TV standards. *General Electric Co., Section X48124, Electronics Park, Syracuse, N. Y.* In Canada, write: *CGE Electronics, 830 Lansdowne Ave., Toronto.*

Plan view of new G-E "Optiplexer" setup.



CAPABLE OF HANDLING FOUR PROJECTION SOURCES as illustrated at left in conjunction with the new G-E "Optiplexer". By using this highly efficient optical system there's *no need to flip mirrors!* And, the new G-E Vidicon channel offers a choice of monitors . . . 1. Studio console type. 2. Lightweight portable design.

Progress Is Our Most Important Product

GENERAL ELECTRIC

TELE-TIPS

(*Continued from page* 36)

SMALL BUSINESS FIRMS are beginning to suffer acutely through the retraction of large quantities of subcontract work for military aviation building. While the Small Business Administration maintains that it is doing all that it can to assist, there appears to be no immediate solution to the growing problem. Delay in bringing Air Force up to 137-wing strength for two years plus discontinuance of manufacture of certain aircraft types are major causes of contract retractions.

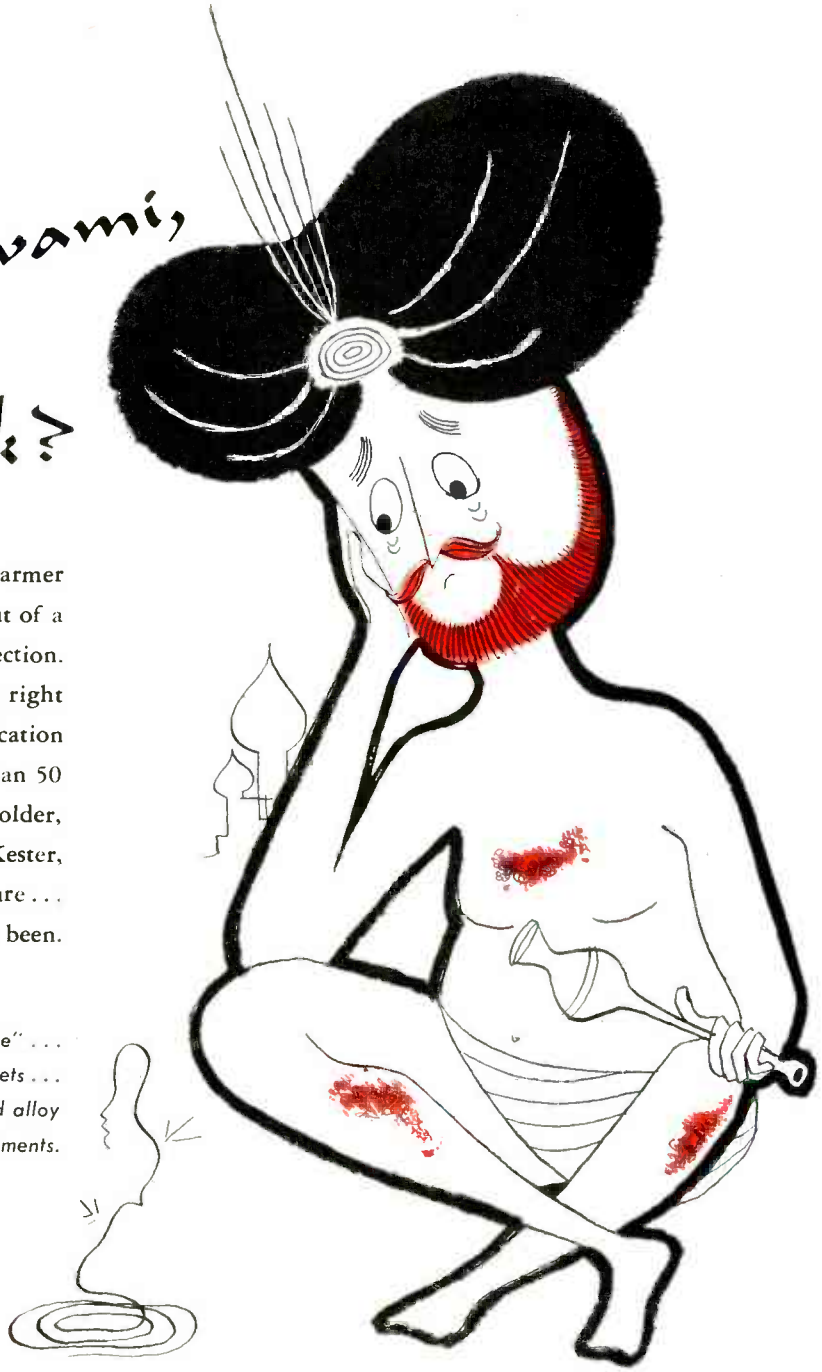
DO-IT-YOURSELF trend has now expanded to become a low cost method of speeding in-plant communications. The Lamson Corp. of Syracuse, N.Y. has developed a prefabricated 2-station pneumatic tube system, in kit form, that can be installed in any type of building by regular maintenance personnel.

KNOCKING THE JOB—some 20,000 times each day soon will be over for 165 girls at GE's Owensboro, Ky., tube plant. The light cork mallets to check for short circuits are being replaced by automatic, solenoid-operated "rappers" on each test set so girls can concentrate only on reading test set dials.

SUBMARINE EARS in the form of rubber panels developed by B. F. Goodrich form part of the hull for the USS Nautilus and house sonar gear for the detection of surface and undersea craft. Installed fore and aft, the "ears" share characteristics of ocean water, thereby preventing distortion of sonar signals.

COMPUTERS FOR DICTIONARIES. The University of Chicago reports that scholars are wondering if some of the essential steps in making a dictionary cannot be by-passed with the use of the new high speed computing machines. When the largest commercially published dictionary in the U.S. was made only two fifths of the entries available in the files ever reached print. To revise it in any major form would cost ten million dollars and it would take one person an estimated fifty to sixty years to proof-read this large dictionary.

S'matter, Swami, won't it work?



Near-sighted or not, our snake charmer friend should know he can get more out of a wire if it has a well soldered connection. How do we know that? Well, making the right kind of flux core solder for every application has been Kester's sole business for more than 50 years. There's no mystery about Kester Solder, no secret ingredients either. With Kester, quality is the paramount feature . . . the same today as it's always been.

TRIPLE-PLAY! Kester "44" Resin . . . "Resin-Five" . . . Plastic Rosin-Core Solder . . . your best bets . . . with exact core size or flux-content and alloy "tailored" to your requirements.

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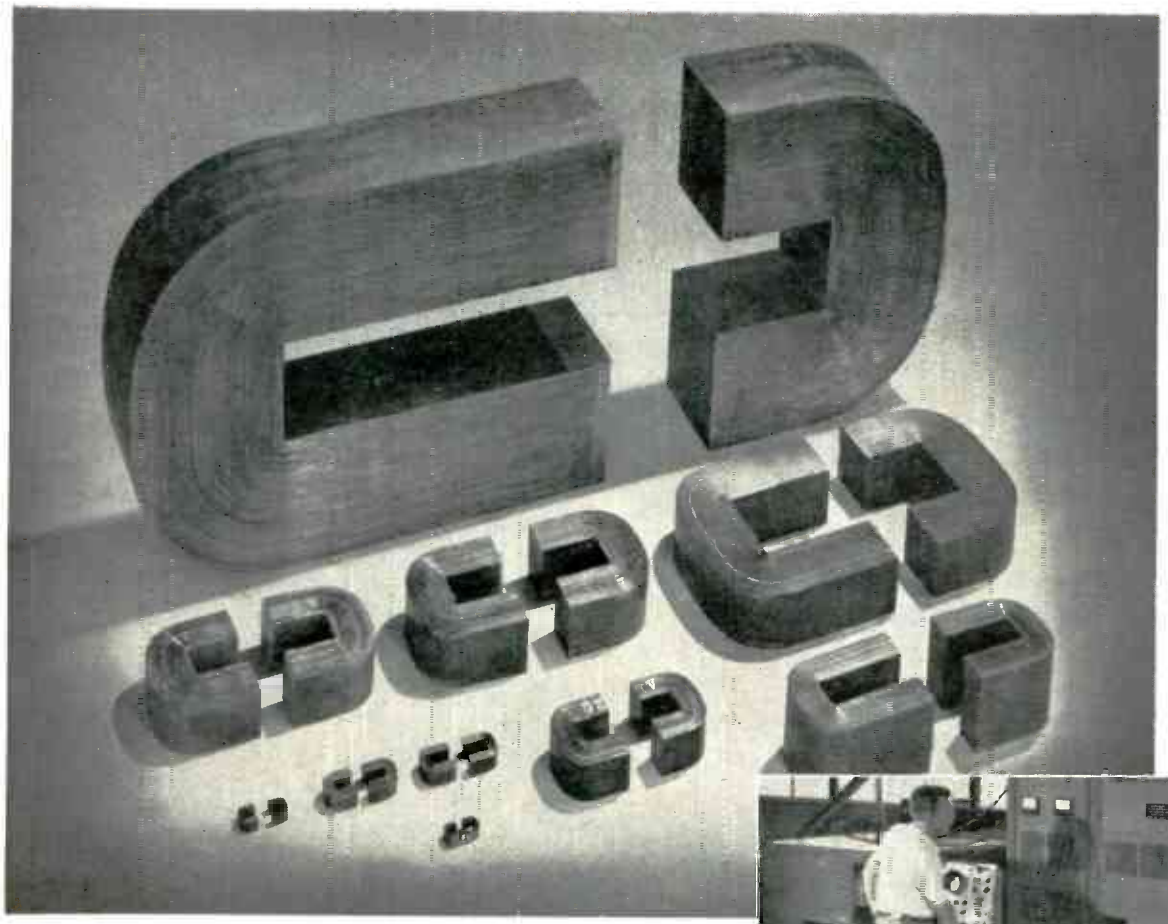
WRITE TODAY for Kester's ***NEW*** 78-Page Informative Textbook, "SOLDER . . . its fundamentals and usage"



Arnold Pulse Transformer Cores are individually tested under actual pulse conditions

W&D 5238

WRITE for your COPIES

"MAGNETIC MATERIALS CATALOG"

General information on all Arnold magnetic materials: permanent magnets, tape-wound and powder cores, types "C" and "E" cut cores, etc.

"ARNOLD SILECTRON CORES"

52 pages of valuable data covering a complete range of core shapes, sizes, tape gauges, etc.

ADDRESS DEPT. T-12

The inset photograph above illustrates a special Arnold advantage: a 10-megawatt pulse-testing installation which enables us to test-prove pulse cores to an extent unequalled elsewhere in the industry.

For example, Arnold 1 mil Silectron "C" cores—supplied with a guaranteed minimum pulse permeability of 300—are tested at 0.25 microseconds, 1000 pulses per second, at a peak flux density of 2500 gausses. The 2 mil cores, with a guaranteed minimum pulse permeability of 600, receive standard tests at 2 microseconds, 400 pulses per second, at a peak flux density of 10,000 gausses.

The test equipment has a variable range which may enable us to make special tests duplicating the actual operating conditions of the transformer. The pulser permits tests at .05, .25, 2.0 and 10.0 microsecond pulse duration, at repetition rates varying anywhere from 50 to 1000 pulses per second.

This is just another of Arnold's facilities for better service on magnetic materials of all description. ● Let us supply *your* requirements.

THE ARNOLD ENGINEERING COMPANY

SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION

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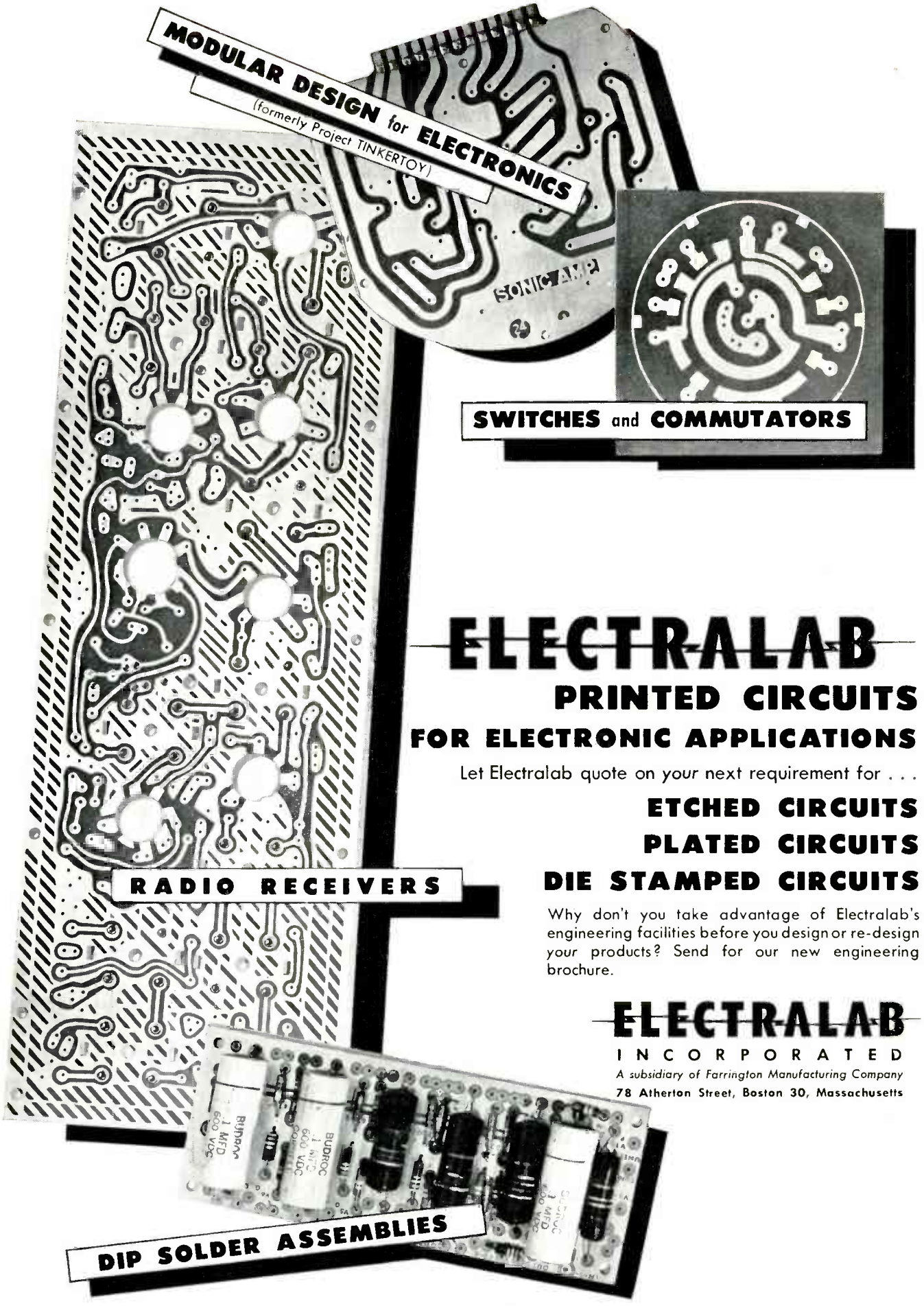

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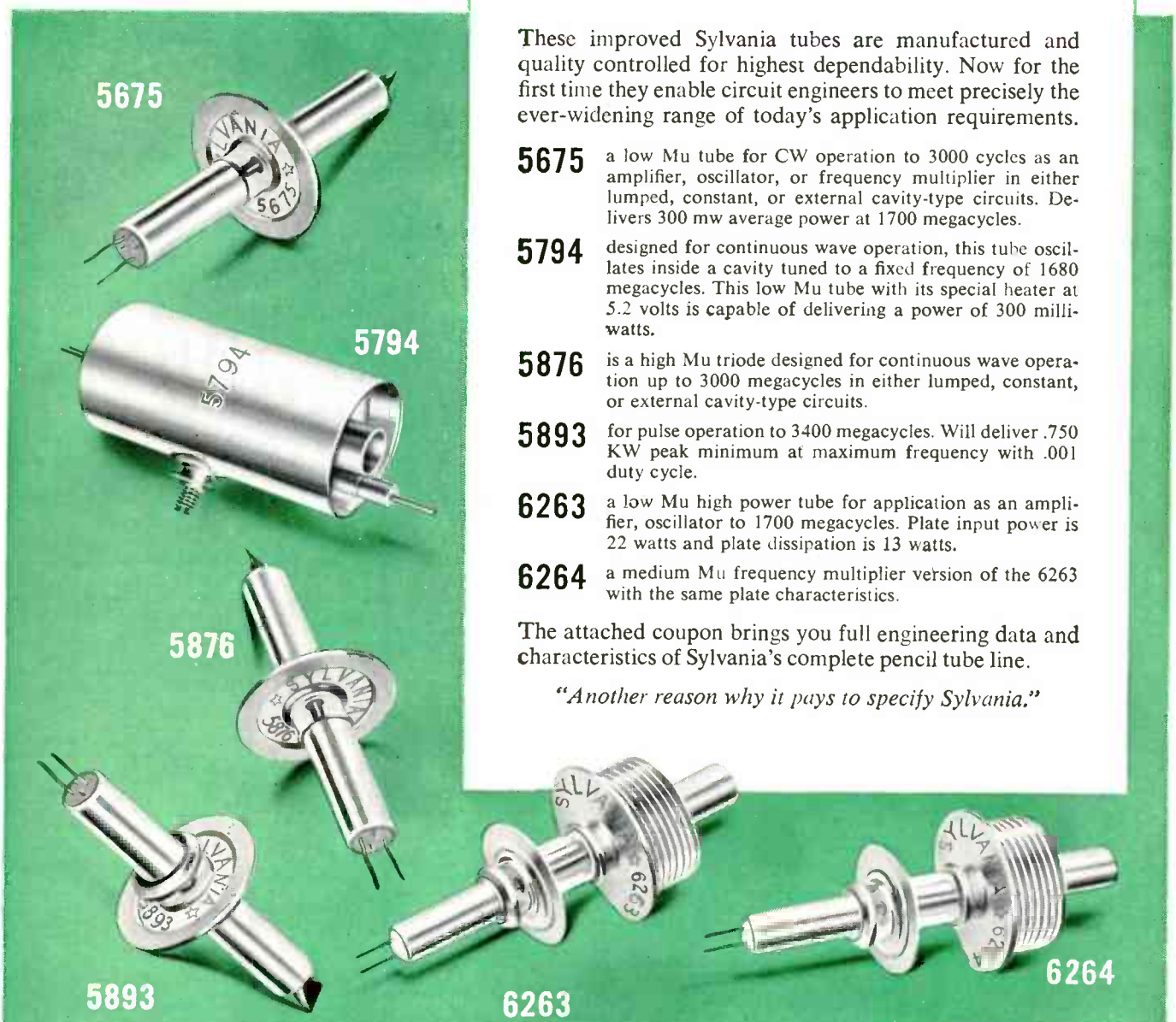
NOW SYLVANIA PRESENTS

a Full Line of PENCIL TUBES



These improved Sylvania tubes are manufactured and quality controlled for highest dependability. Now for the first time they enable circuit engineers to meet precisely the ever-widening range of today's application requirements.

5675 a low Mu tube for CW operation to 3000 cycles as an amplifier, oscillator, or frequency multiplier in either lumped, constant, or external cavity-type circuits. Delivers 300 mw average power at 1700 megacycles.

5794 designed for continuous wave operation, this tube oscillates inside a cavity tuned to a fixed frequency of 1680 megacycles. This low Mu tube with its special heater at 5.2 volts is capable of delivering a power of 300 milliwatts.

5876 is a high Mu triode designed for continuous wave operation up to 3000 megacycles in either lumped, constant, or external cavity-type circuits.

5893 for pulse operation to 3400 megacycles. Will deliver .750 KW peak minimum at maximum frequency with .001 duty cycle.

6263 a low Mu high power tube for application as an amplifier, oscillator to 1700 megacycles. Plate input power is 22 watts and plate dissipation is 13 watts.

6264 a medium Mu frequency multiplier version of the 6263 with the same plate characteristics.

The attached coupon brings you full engineering data and characteristics of Sylvania's complete pencil tube line.

"Another reason why it pays to specify Sylvania."

SYLVANIA

In Canada: Sylvania Electric (Canada) Ltd., University Tower Building
St. Catherine Street, Montreal, P. Q.

Sylvania Electric Products Inc.
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Please send me complete engineering data sheets covering the full line of Sylvania Pencil Tubes.

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12,800 TO 50,000 MC

integrated equipment for

Extremely
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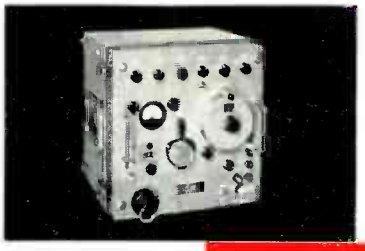

SIGNAL GENERATORS

SIGNAL SOURCES

SPECTRUM ANALYZERS

Now, Polarad has applied its advanced engineering techniques to **produce fully self-contained** microwave test equipment for use in the Extremely High Frequency region--12,800 to 50,000 MC

This new line of Signal Generators, Signal Sources, and Spectrum Analyzers is designed to save engineering manhours in the laboratory and on production lines—obviating experimental test set-ups.

The Extremely High Frequency Polarad Signal Generator, for example, furnishes monitored power output as well as measures external signal strength and frequency.

Highest accuracy and reliability of operation are assured by careful engineering and the use of highest quality components. For complete information write to your nearest Polarad representative or directly to the factory.

	SIGNAL GENERATORS		SIGNAL SOURCES		SPECTRUM ANALYZERS		
Frequency Range	Model Number	Output Power	Model Number	Power Output (Average)	Model Number	Sensitivity (Signal=Noise)	Dispersion (Average)
12.8 to 17.5 KMC	SG 1218	—10 DBM	SS 1218	15 mw	SA 1218	—70 OBM	30 MC
15.75 to 16.25 KMC	SG 1516*	—6 DBM	SS 1516	5 mw	SA 1516	—70 DBM	45 MC
16.25 to 16.75 KMC	SG 1617*	—6 DBM	SS 1617	5 mw	SA 1617	—70 DBM	45 MC
18.0 to 22.0 KMC	SG 1822	—10 DBM	SS 1822	10 mw	SA 1822	—60 DBM	40 MC
22.0 to 25.0 KMC	SG 2225	—10 DBM	SS 2225	10 mw	SA 2225	—60 DBM	40 MC
24.7 to 27.5 KMC	SG 2427	—10 DBM	SS 2427	10 mw	SA 2427	—60 DBM	40 MC
27.27 to 30.0 KMC	SG 2730	—10 DBM	SS 2730	10 mw	SA 2730	—60 DBM	45 MC
29.7 to 33.52 KMC	SG 3033	—10 DBM	SS 3033	10 mw	SA 3033	—60 DBM	45 MC
33.52 to 36.25 KMC	SG 3336	—10 DBM	SS 3336	9 mw	SA 3336	—50 DBM	45 MC
35.1 to 39.7 KMC	SG 3540	—10 DBM	SS 3540	5 mw	SA 3540	—50 DBM	45 MC
37.1 to 42.6 KMC	External Source Power Measurement Range: +6 to +30 DBM Accuracy with Correction: ±2 DB		SS 3742	Approx. 3 mw	I.F. Gain Control: 0 to 40 DB		
41.7 to 50.0 KMC			SS 4150	Approx. 3 mw	I.F. Band Width: 50 KC		
					Sweep Frequency: 5 to 40 CPS		

Modulation: All units except the SG 1516* and SG 1617* can be modulated as follows:

1. Internal
   1000 CPS Square Wave
2. External
   a. Pulse
      Pulse Width: 0.5 to 10 Microseconds
      PRF: 100 to 10,000 CPS
      Pulse Amplitude: 10 volts Pk to Pk Min.
      Polarity: Positive
   b. Sawtooth or Sinusoidal
      Frequency: 100 to 10,000 CPS
      Amplitude: 15 Volts RMS Min.

*Internal variable pulse and FM modulation

Polarad ELECTRONICS CORPORATION 100 METROPOLITAN AVENUE, BROOKLYN 11, NEW YORK

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"THIRD DOWN...SIX TO GO!"

"Van called a 57X . . . We split the line wide open and went for a touchdown."

A Monday morning quarterback interview with Los Angeles Rams' star end, Tom Fears, is recorded during a practice session for broadcast at a more convenient time.

The engineer-interviewer is Bert Berlant, designer-manufacturer of the Berlant Broadcast Recorder BR-1, which is being used here.

A coordinated combination of tape recorder and 4-channel mixer in two matched portable cases made easy work out of a one-man recording job in the field.

"Operational simplicity" was one of the things insisted upon by 382 radio station engineers who "wrote the specs" for this recorder in a nationwide survey that resulted in this outstandingly rugged and dependable machine. The BR-1 was specifically designed to serve you better, both in the studio and in the field.

Its roster of exclusive features includes: PROVISION FOR FIVE HEADS (three are standard): an optional switching arrangement allows both single and dual track operation. UNISYNC DRIVE: a completely new hysteresis synchronous direct drive with 99.8% timing accuracy and total temperature rise of 30 degrees. UNIFIED CONTROL: one simple convenient error-proof lever system. A-B TEST FADER: fades from incoming signal to playback without transients or clicks.

And these additional requested features: Fast forward and reverse at any speed. Instantaneous *Reeloks*. Automatic cut-off. Tape tension arms. Adjustable bias . . . and three motors.

All of the above is what *you*, the engineer, wanted. The man in the figure department wanted dependability and low maintenance cost . . . at the right price! We listened to him, too.

$545 IS THE PROFESSIONAL USERS NET FAIR TRADED PRICE.

You'll want to test it yourself, we know. For a distributor close to you, for more complete technical brochure, write: Berlant Concertone
4917 West Jefferson Boulevard,
Dept. D13 Los Angeles 16, California

THIS IS REPORT NO. 2 IN A SERIES OF FIELD TESTS.

Manufacturers of Concertone. . . world's foremost high fidelity recorders and accessories.

LETTERS . . .

Stop Wasting Engineers!

Editors, TELE-TECH

Thanks very much for sending me the TELE-TECH editorial on "Stop Wasting Engineers!" so promptly. It certainly contains some thought provoking information on a very important subject.

Harris Reinhardt
Manager, Organization Development
Sylvania Elec. Prods. Inc.
1740 Broadway
New York 19, New York

Editors, TELE-TECH

Your editorial, "Stop Wasting Engineers," is excellent and more of this type information should be presented.

If possible, I would certainly appreciate about 15 tearsheets of the article for discussion with California Senators Knowland and Kuechel.

You may have noticed Representative Hinshaw has started logical thinking in terms of push button operations. This article will also be brought to his attention.

Unfortunately the ASME and other societies are very slow and unaware of current events. Some of your short articles in the past have been forwarded to them.

Jud E. White
511 Walnut Ave.
Burbank, Calif.

Ed note: Mr. White is Divisional Engineer at General Controls Co., Glendale, Calif. and associate member of Republican State Central Committee.

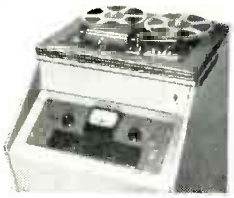
Editors, TELE-TECH

I have read with deep interest your September editorial titled "Stop Wasting Engineers." It expresses most lucidly several sentiments I have long entertained, which are based, I might add, on several years of varied experience in military electronics engineering.

There is, of course, no simple answer to this complex problem. However, I do believe that realistic guiding policies of positive nature should be established by organizations such as the Scientific Manpower Commission. I further believe that Congress would require these policies to be followed if they were aware of the great dangers in the existing situation. At the present time, it appears that most of Congress does not realize the long range implications of our current practices relative to

(*Continued on page 52*)

What's your choice in fine tape equipment?

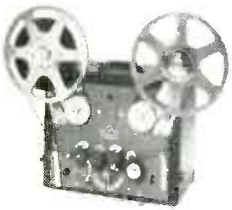


NEW PRESTO SR-11

Complete studio console tape recorder. Never before so much quality, operational ease and value at such a modest price. Embodies the famous PRESTO R-11 tape mechanism, matching amplifier—power supply in sturdy well-designed console cabinet. Three motors for complete flexibility; 15" and 7½" per sec. speeds.

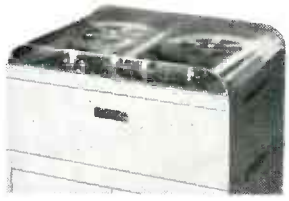
PRESTO R-11

A tape recording mechanism of truly modern design in engineering and operation. Mechanism includes three-head assembly, solenoid operated brakes and employs the exclusive Capstan drive unit. Tape reels mounted directly on heavy-duty torque motors.



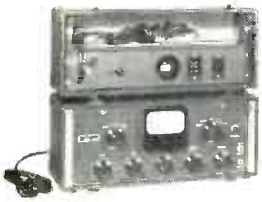
PRESTO R-7

Rugged, portable tape recorder with separate recording, reproduction, and erasing heads. Built around a sturdy, three-motor drive eliminating friction clutch, the RC-7 contains the same high-quality components found in PRESTO'S fine studio equipment. Heavy-duty construction throughout.



PRESTO PB-17A

Reliable, long-playing tape reproducing mechanism. Automatically reversible for continuous playback for background music in eight hour cycles. Frequency response uniform from 50 to 8000 cps. Tape speed: 3¾" per sec. Reels up to 14" diam. (4800' of tape) with dual track.

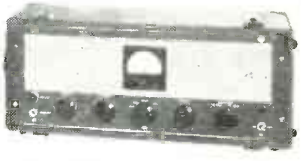


PRESTO 900-A

Precision tape amplifier for portable use or rack mounting. Composed of individual record and reproduce (monitor) amplifiers on a common chassis: separate power supply: three-microphone input, 250 ohm low level mixer: illuminated V.U. meter. Output of reproduce amplifier, 500 ohms, plus 20 db maximum. May be used with any model PRESTO tape recorder.

PRESTO TL-10

Turntable-driven tape reproducer. Unique, low-cost unit that adapts any 16" turntable for reproduction of tape at 7½"/sec. or 15"/sec. with exceptional accuracy. No pre-amplifier required: plugs into standard studio speed input equipment.



PRESTO A-920

More compact than the 900-A. In carrying case or for rack mounting. Consists of microphone preamp, a reproduce preamp, power amplifier and power supply—all on a common chassis. Two small speakers mounted behind front panel for playback. Single mike input: 250 ohms. Playback output: 15 ohms, 10 watts.

PRESTO CDR-200 CAPSTAN DRIVE UNIT

Heart of all Presto tape recorders and reproducers. Motor, capstan and flywheel, pressure pulley and pressure pulley solenoid are mounted on independent cast aluminum chassis. Positive, very quiet tape drive with minimum of parts.

Behind every piece of tape equipment are these PRESTO "extras"—painstaking craftsmanship, years of experience... quality control...and advanced production facilities that guarantee instruments of absolute precision and lifelong dependability.

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Canadian Division: Instantaneous Recording Service, 42 Lombard Street, Toronto

WORLD'S LARGEST MANUFACTURER OF PRECISION RECORDING EQUIPMENT AND DISCS

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Presto Recording Corporation
Tape Equipment Sales Div.
Paramus, New Jersey

Please send full information and prices on the following Presto tape equipment:

☐ SR-11 Tape Recorder ☐ PB-17A Tape Recorder
☐ R-11 Tape Transport ☐ TL-10 Tape Reproducer
☐ R-7 Tape Recorder ☐ A-920 Tape Amplifier
☐ 900-A Tape Amplifier ☐ CDR-200 Capstan Drive

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Type 5000 Adlake Relay

ADLAKE Mercury Relays have won their place by *proven dependability* in jobs which conventional relays can do in an uncertain manner at best. For instance, they have proved their ability to stand up under the most adverse conditions of temperature and moisture . . . normal line voltage fluctuations or ambient temperatures from −38.8° to +200° F. have no material effect on their time-delay characteristics.

What's more, every ADLAKE Relay is hermetically sealed . . . absolutely maintenance-free . . . always silent and chatterless. And ADLAKE's mercury-to-mercury contact provides an ideal snap action.

Yes, wherever sensitivity and dependability are required, ADLAKE Mercury Relays can do the job best! Send for the ADLAKE Relay catalog today . . . no obligation, of course. The Adams & Westlake Company, 1175 N. Michigan, Elkhart, Indiana. In Canada, address Powerlite Devices, Ltd., Toronto.

EVERY ADLAKE RELAY GIVES YOU THESE PLUS FEATURES:

HERMETICALLY SEALED—dust, dirt, moisture, oxidation and temperature changes can't interfere with operation.

SILENT AND CHATTERLESS • REQUIRES NO MAINTENANCE • ABSOLUTELY SAFE

MERCURY-TO-MERCURY CONTACT—prevents burning, pitting and sticking. And every ADLAKE Relay is tested—*and guaranteed*—to meet specifications!

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Adlake TRADE MARK — 97th year of serving the transportation and building industries

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"Precision airborne communication equipment must have a dynamotor of consistently reliable quality . . . that's why we specify Winco."

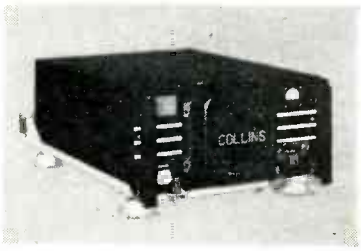
says Mr. Paul Wulfsberg,
Ass't. Director Engineering and Research

COLLINS RADIO CO.

Cedar Rapids, Iowa.

WINCO DYNAMOTORS are manufactured on a wide range of rugged frames that allow for broad design applications. Winco engineers have a decade of experience in successfully designing dynamotors to rigid military and commercial specifications. They tackle each power conversion and/or supply problem individually, either modifying a standard Winco machine, or designing a special unit to meet your exact requirements. Winco specialists then plan its manufacture on a production basis to keep costs down and final performance quality at its best.

Winco dynamotors are lightweght, compact and totally enclosed and ventilated. Precise static and dynamic balance is assured by the most modern machines — each dynamotor is thoroughly tested with periodically calibrated precision meters.



Collins 18S Transmitter/Receiver, used for reliable HF communications in major air-lines and executive aircraft uses a Winco-Engineered Frame 51 Dynamotor.

SEND THIS COUPON TODAY for complete information on how Winco can supply you with reliable, efficient dynamotors and power supplies produced in volume at low cost.

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LETTERS . . .

(*Continued from page* 48)

technical and scientific manpower.

Why don't you perform another service and direct reprints of your excellent editorial to individual congressmen? Perhaps it would serve to stir some constructive action by influential and responsible members. I am sure that many of our legislators are very much interested in the problem, and that your comments would be most welcome.

Again my appreciation for your editorial, and also for a very fine publication.

C. H. Blackerby

The Years Ahead

Editors, TELE-TECH

I have read with great interest, in the October issue of TELE-TECH & ELECTRONIC INDUSTRIES, Dr. Alfred N. Goldsmith's paper, "The Years Ahead." It seems to me that this kind of forecasting is an essential element in the intelligent management of any modern industry. The whole electronics industry, for many years, has benefited from the foresight Dr. Goldsmith has provided.

It must have required courage and a bit of gambling instinct, as well as foresight, to make his predictions and to let them be published. Perhaps he could be reasonably safe in predicting the broad trend of future developments, but there must be almost infinite possibilities for surprises in predicting details.

In any case, Dr. Goldsmith's predictions are stimulating and, since they are based upon years of observation and practical experience, have a good chance of being accurate. In fact, by predicting developments which were possible, he often has provided the inspiration which caused them to be accomplished.

Clarence W. Hansell
Radio Corp. of America
RCA Laboratories
Rocky Point, N. Y.

High Frequency Measurements Confab

The fourth meeting of the Conference on High Frequency Measurements will be held on January 17, 18 and 19, 1955 in Washington, D.C. Headquarters will be at the Hotel Statler and sessions are to be held in the Department of Interior Auditorium. The 1955 meeting will be

(*Continued on page* 166)

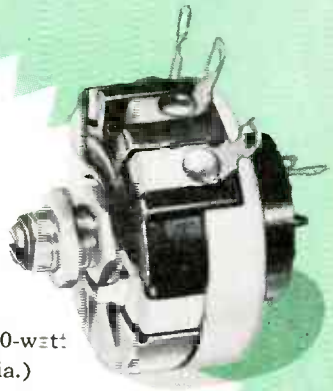
Stand Pat with CLAROSTAT

"Humdinger" Series MH ultra-compact potentiometer. 10 to 2000 ohms. 1 watt.

Miniaturized Series 49 wire-wound controls in single and dual units. 10 to 20,000 ohms. 1.5 watts. Switches available.

"Humdinger" Series 39 shaftless, screwdriver-adjusted potentiometer. 4 to 5000 ohms. 2 watts.

Series 38 3-watt wire-wound controls. 1 to 50,000 ohms. With or without switch.



Wire-Wound CONTROLS

Your wire-wound control needs — *usual* or *unusual* — are readily met by specifying CLAROSTAT. Here's why:

For *usual* needs, the Clarostat line is outstandingly complete. It includes 2-watt (1-1/8" dia.), 3-watt and 4-watt (1-21/32" dia.) types; 25- and 50-watt power rheostats; miniaturized (3/4" dia.) 1.5-watt controls; and the handy, space-saving, cost-reducing "Humdingers"*. All these types, and many more, are *standard and stocked*, available for your convenience at the local Clarostat distributor or in quantities from Clarostat factory stock.

And for *unusual* needs, Clarostat can design and put into production those *special* types — quickly, satisfactorily, economically — often based on ingenious adaptations of standard features and tooling.

Send those wire-wound control requirements to us for engineering service and quotations. Literature on request.

Smaller or Series 43c 2-watt wire-wound controls. 5 to 50 K ohms. With or without switch.

Power rheostats, Series 25 and 50, 25 and 50 watts. 5,000 and 10,000 ohms max., respectively. Also aircraft type, encased in metal housing

Series 10 4-watt wire-wound controls. 1 to 100,000 ohms. With or without switch.

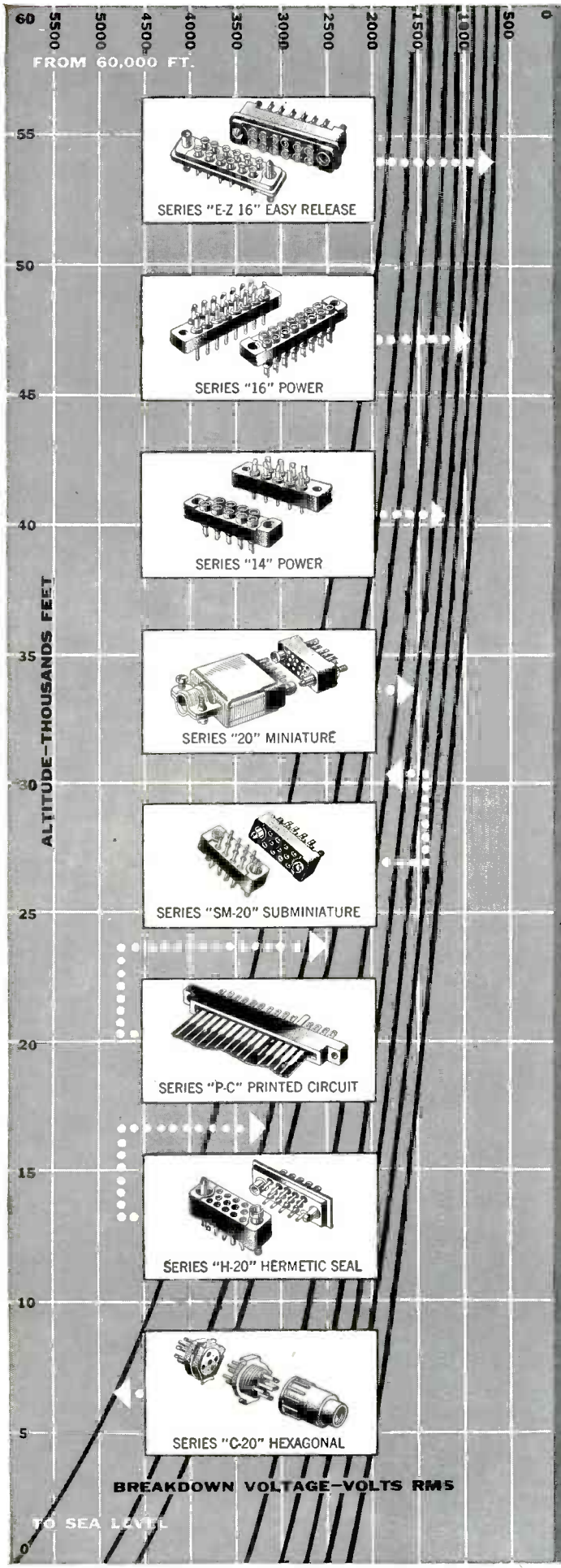
CLAROSTAT®

Controls and Resistors

CLAROSTAT MFG. CO., INC., DOVER, NEW HAMPSHIRE

In Canada: Canadian Marconi, Co., Ltd., Toronto 17, Ont.

*Reg. U.S. Pat. Office



new... precision **Continental Connectors**

simplify your connector problems

Printed Circuit Connectors

Series P-C—With 6, 10, 15, 18, 22, and 28 contacts in single or double rows

Answers the need for a positive, space-saving connection between printed circuitry and conventional wiring. Permits direct connection to a printed circuit "plug" mounted sub-assembly. By specifying 28 contacts in a double row connector and using both sides of the printed circuit card you have provision for up to 56 individual connections for #16 AWG wire.

Series P-C Connectors can be custom built to suit any card thickness, and are available in Mineral filled Melamine, Plaskon Reinforced (glass) Alkyd type 440-A, and Diallyl Phthalate (blue) insulating materials.

Write for Engineering Literature, Series P-C, to Department TT, DeJUR-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.

Electronic Sales Division **DeJUR**

45-01 Northern Blvd., Long Island City 1, N. Y.

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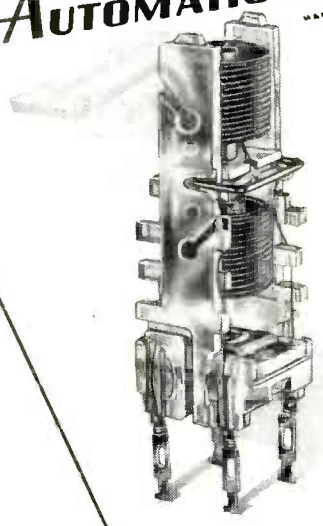

The excellent uniformity and stability of G A & F Carbonyl Iron Powders have enabled us to develop a special process for the production, in extremely large quantity, of a complex tuning core that is the heart of the K-TRAN.

Your product has enabled us to design into our K-TRAN both the high electrical performance and the unparalleled mechanical and climatic stability (otherwise obtainable only in larger and more expensive units) so eagerly sought after by K-TRAN users.

AUTOMATIC MANUFACTURING CORPORATION

Morton W Benedek

President

SIZE SIZE SIZE WHEN SIZE IS A FACTOR

— G A & F CARBONYL IRON POWDERS

THE K-TRAN—made by Automatic Manufacturing Corporation—measures only ¾" across. Yet it is available in RF and IF transformers covering frequency ranges from 20 KC to 30 MC and higher! For its size, it covers the widest range of uses in the IF field—and with unsurpassed stabilities. . . . As indicated, the makers credit K-TRAN's success, in large measure, to the controlled uniformity of G A & F Carbonyl Iron Powders.

Today there are ten types of iron powders made by the Carbonyl Iron Process—with the particle sizes ranging from 3 to 20 microns in diameter. The iron content of some types is as high as 99.6 to 99.9%.

With quite different chemical and physical characteristics, the ten types lend themselves to many different uses—to increase Q values, to vary coil inductances, to reduce the size of coils, to confine stray fields and to increase transformer coupling factors. The Carbonyl Process assures the quality and uniformity of each type.

We urge you to ask your core maker, your coil winder, your industrial designer, how G A & F Carbonyl Iron Powders can increase the efficiency and performance of the equipment or product you make, while reducing both the cost and the weight. We also invite inquiries for powders whose performance characteristics are different from those exhibited by any of our existing types.

This 32-page book offers you the most comprehensive treatment yet given to the characteristics and applications of G A & F Carbonyl Iron Powders. 80% of the story is told with photomicrographs, diagrams, performance charts and tables. For your copy—without obligation—kindly address Department 92.

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A SALES DIVISION OF GENERAL ANILINE & FILM CORPORATION

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MEMBER mpa METAL POWDER ASSOCIATION

INDUSTRY NEWS

Robert A. McGinnis has been elected to the position of vice president and general mgr. of American Lava Corp. subsidiary of Minnesota Mining & Mfg. Co. Mr. McGinnis had previously been manufacturing mgr. of 3M's international division.

James P. Buckley has been named to the new position of regional sales mgr. on the West Coast for 4 divisions of Bendix Aviation Corp.—Eclipse Pioneer Div., Red Bank Div., Utica Div., and Pioneer Central Div.

Emmet G. Cameron and **Merle R. Zinser** have become Vice President for production and Financial Vice President, respectively, at Varian Associates, Palo Alto, Calif.

E. G. Cameron

M. R. Zinser

Martin F. Bennett has been assigned to the position of Director of Regional Operations for Radio Corp. of America. He will supervise operations of RCA's 8 regional offices.

Stanley Kramer has been appointed ass't. sales manager of the Semi-Conductor Div. of Radio Receptor Co., Inc., New York, N. Y.

Art Brown has become advertising manager of Jensen Mfg. Co., speaker mfr. of Chicago, Ill.

Fred Okon has been promoted to advertising mgr. of CBS-Columbia Div. of Columbia Broadcasting System, and will report to **Gerald Light**, CBS-Columbia advertising and sales promotion Director. **Will James** former director of plant operations at this division, has been named Director of Operations and will be responsible for all purchasing and mfg.

James L. Brown has been named regional manager of midwest sales for CBS-Hytron Div. of Columbia Broadcasting System. His headquarters will be in the Chicago office of the firm.

Albert A. Pulley, manager of general recording at RCA Victor Records Div., has been elected president of the Audio Engineering Society, succeeding **Jerry B. Minter**, pres. of Components Corp., Denville, N.J.

(*Continued on page* 62)

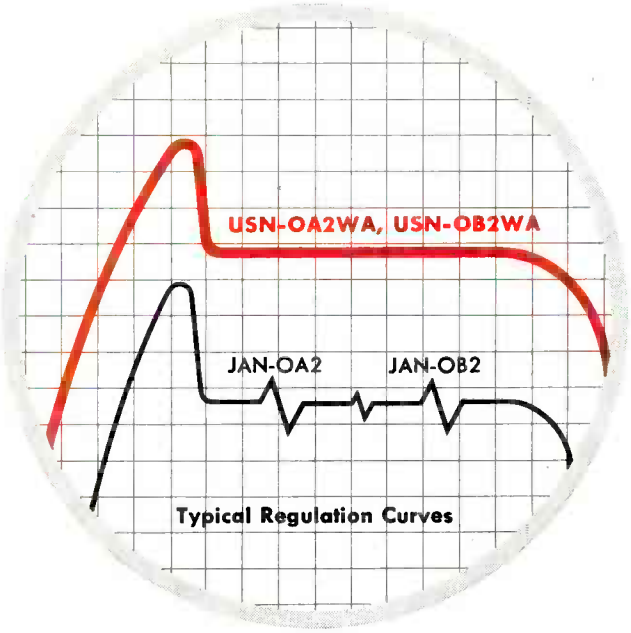
NOW...VR TUBES WITHOUT "PIPS"!

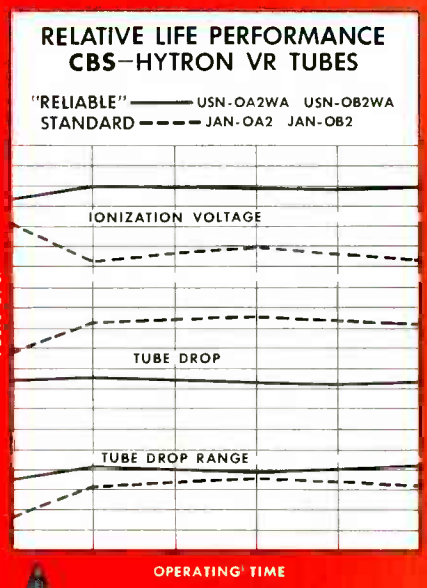
...for Stable Voltage Reference

NEW "RELIABLE"...DUAL-PURPOSE CBS-HYTRON USN-OA2WA USN-OB2WA*

CBS-Hytron, the leader in VR tubes, has solved the "unsolvable" VR-tube problem. Has taken those annoying "pips" (sudden discrete voltage shifts) out of two new CBS-Hytron VR developments: The dual-purpose USN-OA2WA and USN-OB2WA. Both are superior, "reliable" voltage regulators. Both also achieve stable voltage-reference performance.

These new tubes are directly interchangeable with the JAN-OA2 and JAN-OB2. But they are manufactured and tested to new, more rigid U. S. N. Bureau of Ships specifications. USN-OA2WA and USN-OB2WA are designed for dependability under severe environmental conditions . . . and for a wide range of applications. Improved construction and tight quality control offer many advantages. Check features, curves, and construction of these versatile tubes.

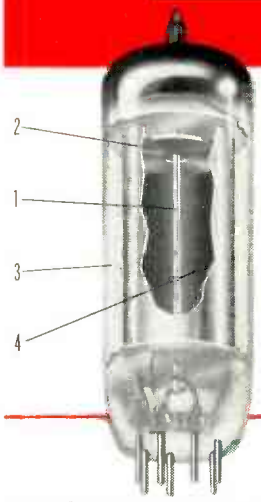




* *Improved tubes, tested to U. S. N. specifications, not to be confused with earlier JAN "reliable" versions.*

CHECK THESE FEATURES

1. Flat, smooth voltage-current characteristic.
2. Greatly improved voltage repeatability.
3. Stable electrical characteristics.
4. Tested under severe conditions of shock, vibration, temperature, and altitude.



IMPROVED CONSTRUCTION USN-OB2WA

Note these improvements: 1. New, simplified aluminum-rod anode. 2. New disc-type starting electrode, to minimize gap-spacing variations and give more uniform starting voltage. (In USN-OA2WA, this electrode is located at bottom of mount assembly.) 3. New gas fill with neon body and low argon content. 4. New composite nickel-aluminum cathode work surface. Improvements 3 and 4 make possible operation at 150°C . . . and stable voltage-reference applications.

FREE DATA for both USN-OA2WA and USN-OB2WA. Write for Bulletin E-235.

CBS-HYTRON Main Office: Danvers, Mass.

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A member of the CBS family: CBS Radio • CBS Television • Columbia Records • CBS Laboratories • CBS-Columbia • CBS International • and CBS-Hytron

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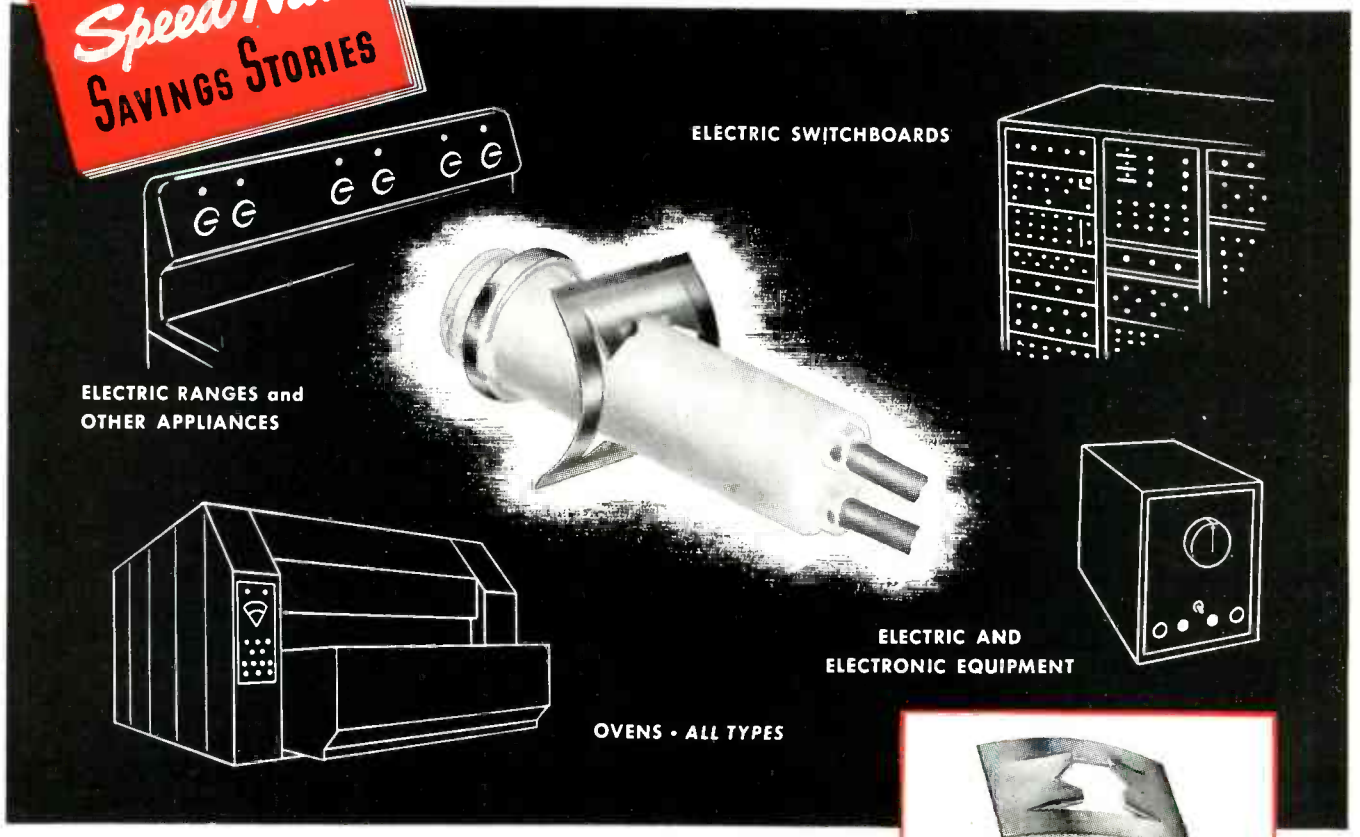
FASTEST THING IN FASTENINGS®



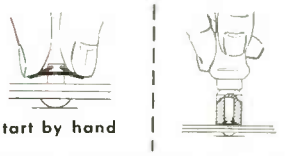
SPEED NUTS "flash" 75% cost savings on pilot-light attachment

Tinnerman Push-On type SPEED NUTS are strongly recommended for fastening Omni-Glow Pilot Lights over several alternate methods by Industrial Devices, Inc., Edgewater, New Jersey. In fact, they are furnished as standard mounting equipment with every order. The reason: production and cost records prove Push-On type SPEED NUTS save up to 75 per cent over other fastening methods.

Tinnerman Push-Ons provide lightning-fast, vibration-proof attachments on thick or thin panel installations and they prevent turning and slipping. Costly tooling, mounting brackets, tapped holes, washers, welded or complicated threaded fastening devices are all eliminated. The results are lower material costs, faster assembly, less parts handling.

See your Tinnerman representative for more cost-saving information on these and other SPEED NUT brand fasteners.

PUSH-ON SPEED NUTS

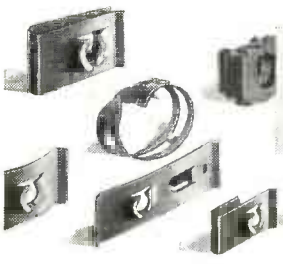


Start by hand

For a wide range of stud shapes and sizes, these one-piece, self-locking spring steel fasteners zip over plain die cast or plastic studs, rivets, tubing, nails, etc. Bite into hardest, smoothest surfaces—lock firmly under live spring tension on metal, plastic or wood.

Write today for your copy of "SPEED NUT SAVINGS STORIES", testimonials of outstanding savings to industry. TINNERMAN PRODUCTS, INC., Department 12, Box 6688, Cleveland 1, Ohio.

In Canada: Dominion Fasteners Ltd., Hamilton, Ontario. *In Great Britain:* Simmonds Aerocessories, Ltd., Treforest Wales. *In France:* Aerocessoires Simmonds, S. A. —7 rue Henri Barbusse, Levallois (Seine).



TINNERMAN Speed Nuts®

MORE THAN 8000 SHAPES AND SIZES

CONFIDENCE

• You can place your orders for printed circuitry and allied electronic sub-assemblies in the hands of Photocircuits Corporation with assurance of satisfaction for these reasons:

SUCCESS. Photocircuits Corporation has produced more printed circuits of the etched foil variety than any other company. It has an unexcelled reputation for reliability of quality and production performance. Photocircuits Corporation has played the largest part in bringing to maturity the young printed circuit industry.

RESEARCH, a never-ending activity at Photocircuits Corporation, does not stop with experimentation on production methods! Many suppliers, as well as its customers, have benefited greatly by Photocircuits' research efforts. Photocircuits Corporation's initiative has been the bulwark and bellwether of the industry's development of a variety of insulator-conductor laminates for printed circuitry.

SPECIALIZATION. At Photocircuits Corporation "printed circuitry" is the *sole aim and product.* Engineering and production staffs concentrate only on producing the best for each application of electronic and electrical circuitry . . . extending to switches, commutator discs etc.

TECHNICAL AUTHORITY. Coupled with actual production, the Photocircuits Corporation technical staffs have developed for the trade press authoritative information to aid the entire industry. This is also the product of pioneering, of concentration, of successful achievement. Engineering bulletins, furthermore, have been produced on all phases of design and production of printed circuitry. These are available to all on request.

Photocircuits
CORPORATION

Pioneers in Cost-Cutting Printed Circuit Techniques
GLen Cove 4-4000 • FLushing 3-5050

BOSTON: 25 Huntington Ave. • COmmonwealth 6-7705
CHICAGO: 4258 W. Irving Park Rd. • PAlisades 5-1170
PHILADELPHIA: 1531 Spruce St. • Kingsley 5-1205
ROCHESTER, N. Y.: 3 Juniper St. • CUlver 7635
LOS ANGELES: 7407 Melrose Ave. • WEbster 3-7276
DAYTON, O.: 1521 Burroughs Drive • RAndolph 5907
KANSAS CITY, MO.: 903 McGee St. • Victor 8090

The information indicated in the coupon is yours on request.

PHOTOCIRCUITS CORPORATION
Dept. TT12, GLEN COVE, N. Y.

Please send us the literature items checked:

- ☐ *1954 Engineering Brochure*
- ☐ *P-1 Fabrication*
- ☐ *P-2 Base Materials*
- ☐ *P-3 Platings & Plated-Thru Holes*
- ☐ *P-4 Etched or Plated Conductor Characteristics*
- ☐ *P-5 Printed Components*
- ☐ *P-6 Switch Plates & Commutator Discs*
- ☐ *P-7 Assembly & Dip Soldering*
- ☐ *P-8 Layout & Design*

NAME.....
COMPANY.....
ADDRESS.....
CITY.....ZONE.....STATE.....

* Trade Mark

She keeps Case History Records of *every* Stackpole iron core ever made!

Producing iron cores that are really uniform, or matching a new batch of cores to the exact specifications of a previous run are critical jobs!

That's why the files from which the above sketch was made are basic in assuring Stackpole iron core superiority in these all-important respects. For here are kept careful *formula records and production case histories of every Stackpole iron core ever made.*

Guesswork goes out the window. These files backed by over a quarter of a century's experience in molding top quality components from metal powders mean that each and every Stackpole core is exactly as you want it . . . electrically as well as mechanically. *And each one made to a given specification is exactly like the others.*

Electronic Components Division
STACKPOLE CARBON COMPANY,
St. Marys, Pa.

STACKPOLE

BLAW-KNOX tower designed and fabricated

....to accommodate special automatic two-man elevator

When WWJ-TV, Detroit, wanted an automatic elevator in their new tower, Blaw-Knox went to work on the design of the tower . . . in close cooperation with the manufacturers of both the elevator and the control system.

The result is this tremendous triangular tower . . . 14 feet on each side, 1063 feet high and weighing 265 tons . . . with special structural features to rigidly support both the 102 foot antenna and the automatic elevator.

Ready accessibility to any part of the tower up to the 980 foot level is provided by special design, completely enclosed automatic elevator. It can be stopped by the operator at any level by means of low frequency inductive carrier control. In addition an auxiliary pushbutton station, located at the lower landing, permits manual control at that point. The two controls are interlocked so that only one can be operated at a time. A telephone provides ground-to-car communication.

The advanced design and fabrication of this tower for WWJ-TV typifies the kind of service which Blaw-Knox offers you . . . to meet *your* specific requirements.

For more complete information on all types of Blaw-Knox Antenna Towers, write or phone for your copy of Bulletin No. 2417. Or send us your inquiry for prompt service, specifying height of tower and type of antenna.

BLAW-KNOX COMPANY
BLAW-KNOX EQUIPMENT DIVISION • TOWER DEPARTMENT
PITTSBURGH 38, PENNSYLVANIA

Elevator-Marshall Elevator Company, Pittsburgh, Pa.
Control system—Union Switch & Signal Division of Westinghouse Air Brake Company, Wilmerding, Pa.

BLAW-KNOX **ANTENNA TOWERS**

Guyed and self-supporting — for AM • FM • TV • microwave • communications • radar

INDUSTRY NEWS

(*Continued from page 56*)

P. F. Brophy has been elected to the office of President of R. W. Cramer Co., Inc., Centerbrook, Conn. He succeeds Mr. **R. W. Cramer,** founder and first president of the company, who has become Chairman of the Operating Committee.

P. F. Brophy

A. S. Clarke

Board of Directors of Nat'l. Electrical Machine Shops, Inc., have elected Mr. **A. S. Clarke** president of the Silver Spring, Md., firm. He was formerly vice-president in charge of engineering.

Walter E. Sutter has been appointed mgr. of sales for instruments and industrial electronic products of Commercial Equipment Dept. of General Electric, and **Wayne E. Wright** has become sales engineer handling the Component department's ferrite products at G. E. in Syracuse, N. Y.

Gen. Walter Bedell Smith, former Under Secretary of State, has been elected Vice-Chairman of the Board of Directors of American Machine & Foundry Co.

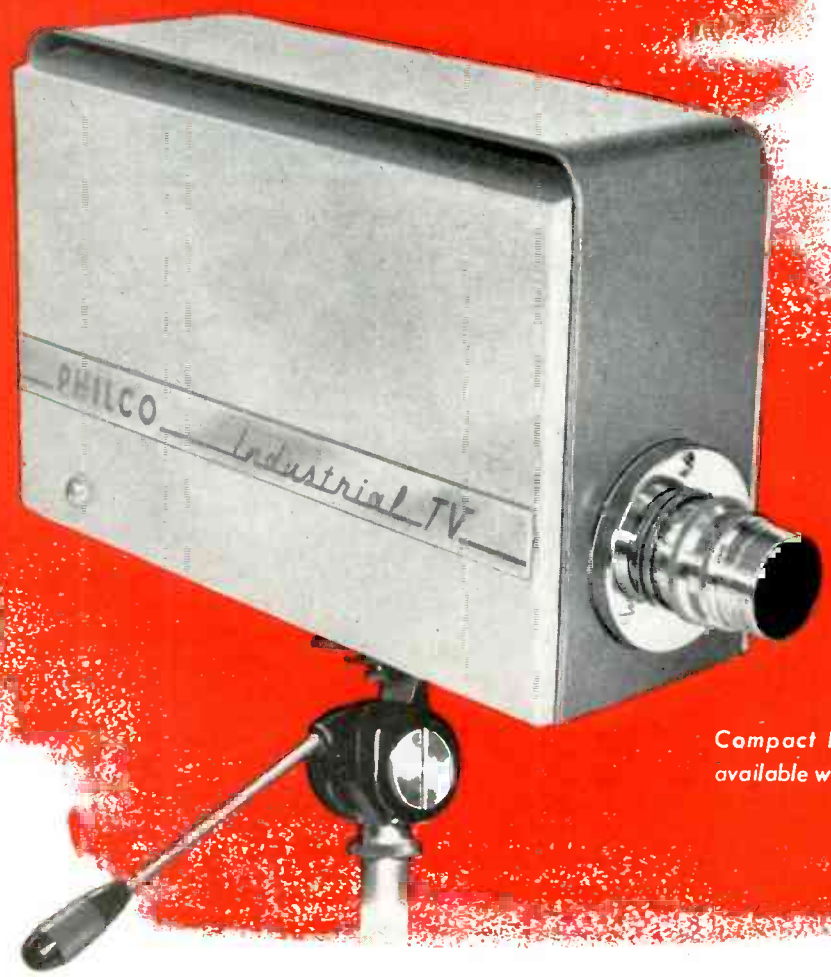
W. B. Smith

M. B. Carlton

M. Barry Carlton has joined Magnavox Co., Fort Wayne, Ind., as general mgr. of the defense products division. For the past 6 years Mr. Carlton has served as executive director and coordinator of reliability in the office of the Secretary of Defense.

Eugene E. Broker has become manager of the Sylvania radio tube plant at Shawnee, Okla. He succeeds **Charles W. Hosterman** who was named to the new post of ass't general mgr. of the Electronics Div.

(*Continued on page 164*)



New!

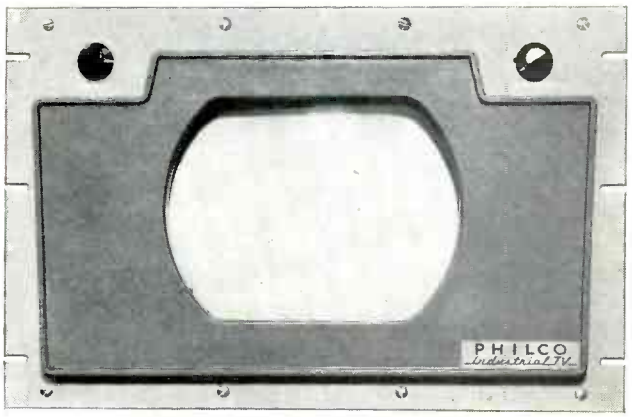
PHILCO INDUSTRIAL TV

Compact Philco Industrial TV camera also available with remote pan, tilt and lens focusing.

A SUPERVISORY TV SYSTEM FOR INDUSTRIAL APPLICATIONS

NOTE THESE FEATURES:

- ✓ *Professional, high-definition monitor*
- ✓ *Operation at extremely low light levels*
- ✓ *Complete remote control of camera*



Philco professional TV monitor

Here is an amazing industrial TV system by PHILCO—a new management tool which now makes supervision by TV practical and economical for the factory and office.

A high-definition monitor displays distant objects and people with brilliance and clarity—with a "presence" . . . as though you were on the scene.

The new camera—one of the smallest yet developed—performs in dimly lighted areas, operates unattended for long periods of time . . . *can be completely controlled from a remote location!*

Get complete data on this new industrial TV equipment . . . let PHILCO help you plan your system. Write today to PHILCO, Dept. T .

PHILCO CORPORATION

GOVERNMENT AND INDUSTRIAL DIVISION

PHILADELPHIA 44 PENNSYLVANIA

In Canada: Philco Corporation of Canada Limited, Don Mills, Ontario

BOOKS

Modern Physics for the Engineer

Edited by Louis N. Ridenour Published 1954 by McGraw-Hill Book Co., Inc. 330 West 42 Street, New York City. 499 pages Price $7.50

This volume comprises a collection of lectures delivered to an extension course at the University of California. Dr. Ridenour, who edited this volume, has collected the lectures under three main categories. Part One, The Laws of Nature, covers physics in its narrow definition—what we know of matter, of radiation and the laws of their interaction. The second part, Man's Physical Environment, discusses the application of physical laws and techniques of investigation to the study of the universe, of the earth and of the air. The third section deals with the application of physics to that branch of engineering known as modern electronics. Some interesting chapter headings include: Astrophysics; High Pressure Phenomena and Geophysics; Thunderstorms and Lightning Strokes; Transient Phenomena in Supersonic Flow; Semiconductor Electronics; Communication Theory and Computing Machines.

BOOKS RECEIVED

Report on Available Environmental Test Facilities for Testing Electronic Equipment

Prepared for the Reliability Committee of the Radio - Electronics - Television Manufacturers Association, 8½ x 11, soft cover, 140 pages (appr.) Price $10.00 Contains company names, addresses, persons to contact for organizations in U.S. having radio noise, shock, vibration, and environmental chambers for testing electronic equipment to meet military specifications. Equipment available at each laboratory listed on separate sheets. Available from RETMA Engineering Office, Room 1015 500 Fifth Avenue, New York 36, N.Y.

Symposium on Temperature Stability of Electrical Insulating Materials

A compilation of the eleven papers presented at th 57th Annual meeting of the American Society for Testing Materials in Chicago, June 1954. Titles include: Electrical Properties of Thermosetting Plastics at Elevated Temperatures; Electrical Resistivity of Bonded Micaceous Materials at Elevated Temperature; Heat Aging Characteristics of Insulating Varnishes; Effect of Elevated Temperature on Silicon Varnished Glass Fabric for Electrical Insulation. This 141-page heavy paper covered volume available from American Society for Testing Materials, 1916 Race St., Phila. 3, Pa. at $2.75 per copy.

Rod, Bar and Wire Product Information

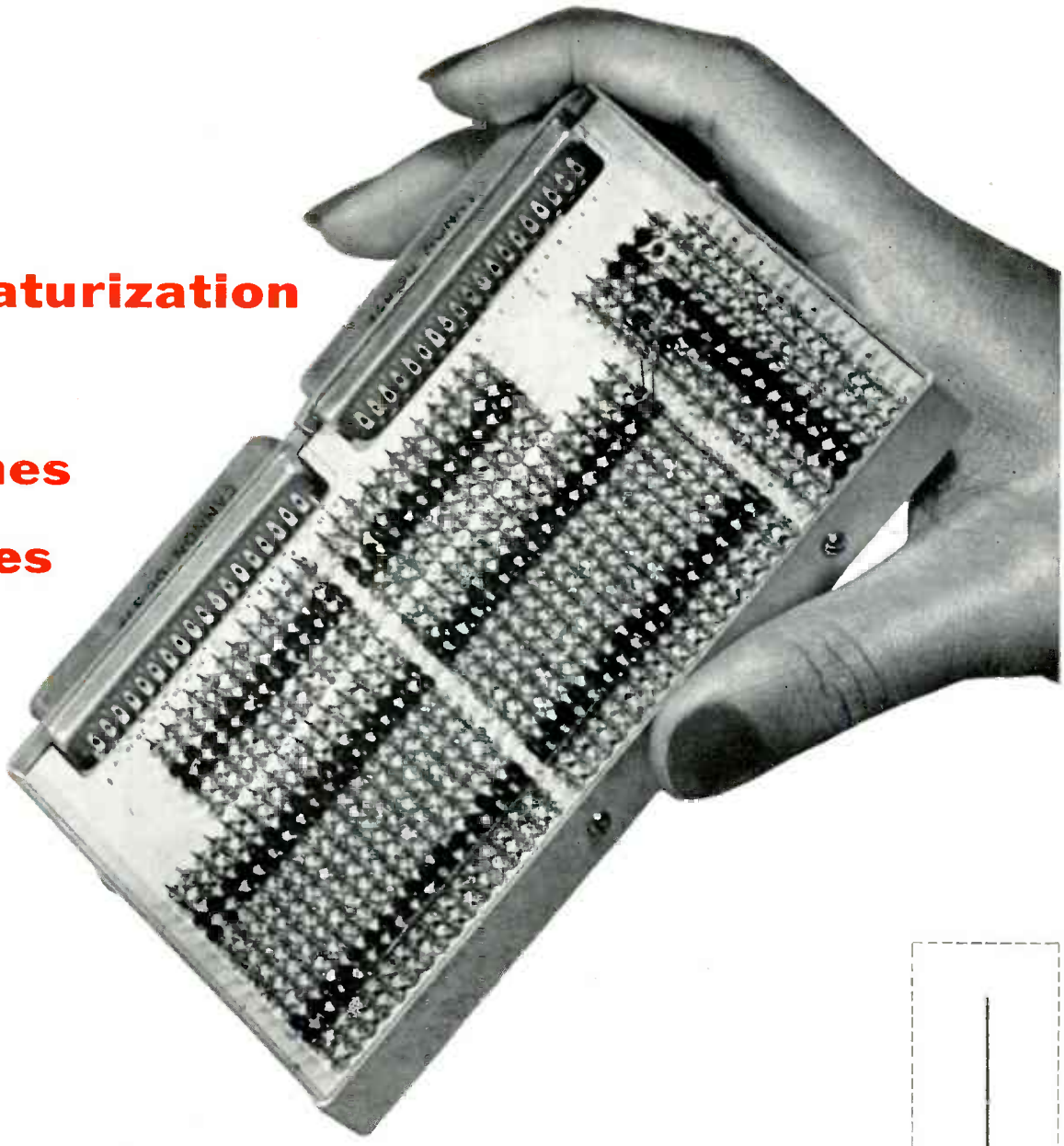
A 160 page, hard covered volume, 5½ x 8½, dealing with the production of aluminum and its specific properties and characteristics as related to rod, bar and wire as well as new data regarding various alloys, their applications, fabrication and finishing methods. Glossary of descriptive words and definitions included as well as numerous engineering tables and nomographs. Available on request on company letterhead or at cost of $2.00 from Technical Editor, Kaiser Aluminum and Chemical Sales Inc., 22 N. LaSalle St., Chicago 1, Ill.

United States Dept. of Commerce Publications

Available through local field offices or from Office of Technical Services, U.S. Dept. of

(Continued on page 68)

Miniaturization with Hughes Diodes

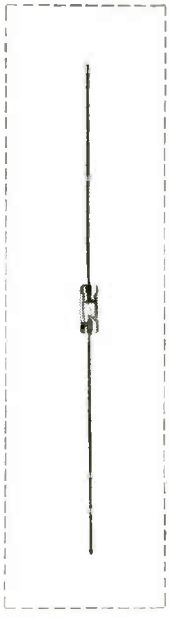


New computer matrix has high component density

This experimental reading gate matrix for airborne computers effectively *utilizes the subminiature size of Hughes Point-Contact Germanium Diodes*. Developed by the Miniaturization Group of Hughes Research and Development Laboratories, the unit measures 5¼ by 3⅛ by ½ inches (excluding plugs and frame). It contains 504 diodes, 209 resistors.* Average component density: *94.5 per cubic inch!*

Frequently, space requirements of conventional wiring techniques will not permit electronic equipment to be miniaturized to the same extent as the components. However, spot-welded connections can effectively reduce wiring space . . . and it is easy to spot-weld the dumet leads of Hughes diodes. There is no adverse effect on diode characteristics, even when the connections are welded close to the diode body. With Hughes diodes, designers can take full advantage of advanced packaging and wiring techniques.

Hughes diodes are easy to mount in conventional assemblies or in subminiature equipment. In service, these diodes have earned a reputation for reliable performance and stability under severe operating conditions. Make your selection from the many standard and special types available – all listed and described in our new Bulletin, SP-2A.



*Actual size, diode body: 0.265 by 0.130 inches, maximum.

Reprints of a paper describing the packaging techniques of the subminiature matrix are available, too. Your copy will be sent promptly on request.

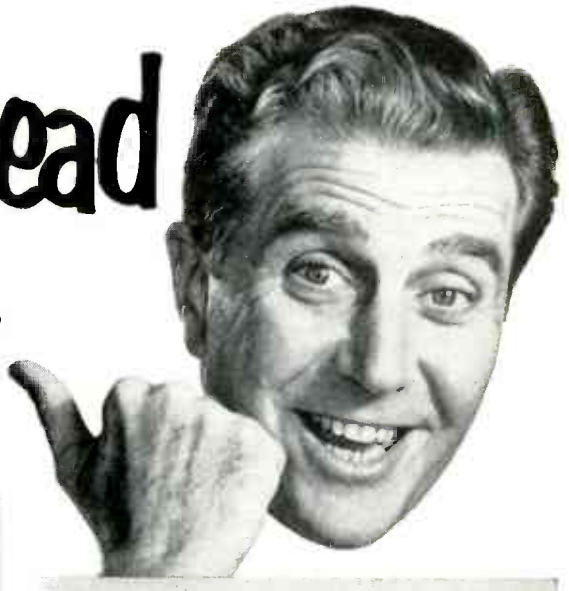
Hughes

Aircraft Company, Culver City, Calif.

SEMICONDUCTOR SALES DEPARTMENT

New York Chicago

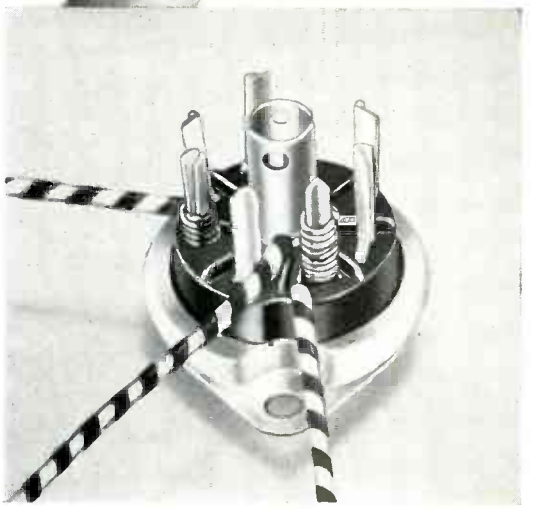
Big Savings Ahead



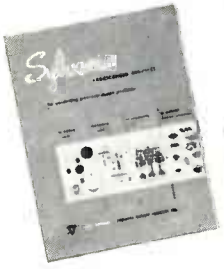
2 New SYLVANIA SOCKETS save Assembly Time... Cut Costs ...Improve Performance!

1. New Sylvania 7-pin Miniature Printed-circuit Sockets. Contacts and center shield are shaped so that sockets can be stacked one upon another for automatic feeding and assembly. Small slots are used on the circuit board to receive the contacts, resulting in stronger chassis construction. Only one socket assembly need be stocked since terminals can be interconnected by printing the circuit on the chassis board rather than using a metallic connector on the socket itself.

Insulator is molded of general-purpose or low-loss phenolic. Contacts are brass or phosphor bronze, plated to suit your specification. Supplied with or without center shield. Now available in 7-pin construction with 9-pin miniature and other types to follow. Tube Shield Ground Strap can also be furnished.



2. New Sylvania Solderless-type Sockets for wire-wrapped connections are now being made in all 7 and 9-pin miniature sizes. Contacts are shaped to provide reliable connections with the use of present wire-wrapping tools.



See the full story of Sylvania's Fabricating Services in Sweet's Catalog — Product Design File. Look for 1b/Sy

For full information *concerning these or other Sylvania parts, or special quality components engineered to your own specifications, write to Dept. 4A-4412, Sylvania today.*

SYLVANIA

Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y.

In Canada: Sylvania Electric (Canada) Ltd., University Tower Building, St. Catherine Street, Montreal, P. Q.

LIGHTING · RADIO · ELECTRONICS · TELEVISION

TUNG-SOL

6550

BEAM POWER AMPLIFIER

HIGH POWER CAPABILITIES (Up to 100 watts output in pairs) **LOW DISTORTION OUTPUT • EXTREMELY UNIFORM CHARACTERISTICS • LONG LIFE**

first in its power range . . designed specifically for audio service

The Tung-Sol 6550 is a brand new and direct approach to the high power design requirements of high fidelity audio amplifiers. For outputs up to 100 watts, two 6550's in push-pull will provide the same power now attained in most existing designs by the use of four or more tubes. In addition to greater audio output, use of the new 6550 results in simplified electrical balance, reduced maintenance and lower cost. The Tung-Sol 6550 is not directly interchangeable with the 6L6, 5881 or KT66 class of tubes. With proper circuitry, however, the 6550 will provide full power output with approximately the same grid voltage drive as the smaller tubes. The 6550 is produced under laboratory conditions with exhaustive quality control to assure premium performance and long life.

Rugged Construction — *The advanced design features which have made the Tung-Sol 5881 so extremely reliable are embodied in the 6550.*

1. Glass button stem construction is strong and compact and provides a rugged support for the tube structure.
2. Micanol wafer and metal shell base provides full lifetime electrical insulation and greater mechanical strength.
3. Cathode materials of exceptional stability give more uniform emission with greater life expectancy. Cathode is not poisoned by inactivity during standby periods.
4. Maximum control of grid emission achieved by gold plating and carbonizing.
5. Triple gettering promotes long, gas-free life. Getters are confined by a spray shield to prevent mica contamination.
6. Life tests are made under severe overload conditions to assure adequate safety factor.

MECHANICAL DATA

Coated Unipotential Cathode	
Outline Drawing	Bulb—Short St-16
Base	Large Wafer Octal 8-Pin Mical with Metal Sleeve B8-86
Maximum Diameter	2 1/16"
Maximum Overall Length	4 3/4"
Maximum Seated Height	4 3/16"
Pin Connections	Retma Basing 7S
Pin 1—Base Shell	Pin 5—Grid No. 1
Pin 2—Heater	Pin 7—Heater
Pin 3—Plate	Pin 8—Cathode and
Pin 4—Grid No. 2	Grid No. 3
Mounting Position	Any

ELECTRICAL DATA

(INTERPRETED ACCORDING TO RETMA DESIGN CENTER SYSTEM)

DIRECT INTERELECTRODE CAPACITANCES — *No Shield*

Grid #1 to Plate	0.85 μμf
Input	14.0 μμf
Output	12.0 μμf

RATINGS

Heater Voltage (AC or DC)	6.3 ±10% VOLTS
Maximum DC Plate Voltage	600 VOLTS
Maximum Plate Voltage (Triode Connection)	450 VOLTS
Maximum Plate Dissipation (Triode Connection)	40 WATTS
Maximum DC Grid #2 Voltage	400 VOLTS
Maximum Grid #1 Voltage	—300 to 0 VOLTS
Maximum Plate Dissipation	35 WATTS
Maximum Grid #2 Dissipation	6.0 WATTS
Maximum DC Cathode Current	175 MA.
Maximum Heater-Cathode Voltage	
Heater Positive (Peak) (DC not to exceed 100V)	+200 VOLTS
Heater Negative (Peak or DC)	—300 VOLTS
Maximum Grid #1 Circuit Resistance (Fixed Bias)	50 KILOHMS
Maximum Grid #1 Circuit Resistance (Self Bias)	250 KILOHMS
Maximum Bulb Temperature	250 °C

HEATER CHARACTERISTICS

Heater Voltage	6.3 VOLTS
Heater Current	1.8 AMP.

The TUNG-SOL engineering which has produced the 6550 is constantly at work on a multitude of special electron tube developments for industry. Many exceptionally efficient general and special purpose tubes have resulted. Technical data sheets, or circuitry suggestions for the 6550 may be obtained by writing to Tung-Sol Commercial Engineering Department.

TUNG-SOL ELECTRIC INC., Newark 4, New Jersey — Sales Offices: Atlanta, Chicago, Columbus, Culver City (Los Angeles), Dallas, Denver, Detroit, Newark Seattle
TUNG-SOL makes All-Glass Sealed Beam Lamps, Miniature Lamps, Signal Flashers, Picture Tubes, Radio, TV and Special Purpose Electron Tubes and Semiconductor Products

TUNG-SOL®
ELECTRON TUBES

BOOKS

(*Continued from page 64*)

Commerce, Washington 25, D.C. Checks payable to Treasurer of the United States.

Metal Coatings on Non-Metallic Materials. A nine volume guide to the techniques of depositing metal coatings which includes: PB 111326, Vol. 1, Silver Films, 138 pp., $2.00; PB 111327, Vol. 2, Copper Films, 37 pp., $1.00; PB 111330, Vol. 3, Nickel Films, 14 pp., $1.00; PB 111331, Vol. 4, Lead Sulphide Films, 19 pp., $1.00; PB 111332, Vol. 5, Gold Films 17 pp., $1.00; PB 111333, Vol. 6, Mechanical Films, 21 pp., $1.00; PB 111334, Vol. 7, Metallic Paints for Printed Circuits and Other Uses, 30 pp., $1.00; PB 111335, Vol. 8, Vacuum Coating Methods, 22 pp., $1.00; PB 111336, Vol. 9, Applications of Metal Films on Commercial Products, 29 pp., $1.00.

Some Ultrasonic and Sterilazation Research. Significant advances in fields of ultrasonic energy, sound propagation and electronic and radiological sterilization. PB 111190, 27 pp., $0.50.

Materials Suitable for Sound Applications: Ultrasonic Velocities and Impedance of Selected Liquids PB 111234, 44 pp., $1.25.

Transistor Circuits Components. Survey of miniature electronic components alreay available and under development. PB 114778. Photocopy $4.00, Micro film $2.25. 22 pages.

Progress Report on Reliability of Electronic Equipment. PB 111455 20 pages, $0.50.

The Automatic Office

By Messrs. Alden, Cleminshaw, Dinsmore, McClay, Pearsall, Williams and Windsor 48 pages, 8½ x 11. A study of the applications of electronic digital computer principles to the automatization of clerical and accounting routines. Price $5.00. Available from William L. Alden. Alden Systems Co., Alden Research Center, Westboro, Mass.

Eastern Joint Computer Conference and Exhibition

Eastern Joint Computer Conference and Exhibition will be held at the Bellevue-Stratford Hotel, Philadelphia, Dec. 8, 9 and 10, 1954, and the following papers will be presented:

WEDNESDAY, DECEMBER 8

"Small Computers in a Large World," C. W. Adams, Digital Computer Lab., M.I.T.

"Characteristics of Currently Available Small Digital Computers," Alan J. Perlis, Computing Lab., Purdue Univ.

"Why Not Try a Plugboard," Rex Rice, Jr., Northrop Aircraft, Inc.

"Techniques for Increasing Storage Density of Magnetic Drum Systems," Harrison W. Fuller, Paul A. Husman, Robert C. Kelner, Lab. for Electronics Inc.

"Application and Performance of Magnetic Core Circuits in Computing Systems," Robert D. Kodis, Raytheon Mfg. Co.

"A Self Checking High Speed Printer," Earl Masterson, Abraham Pressman, Eckert-Mauchly Div., Remington Rand, Inc.

"Teletype High Speed Tape Equipment and Systems," William P. Byrnes, Teletype Corp.

THURSDAY, DECEMBER 9

"Operating Characteristics of the National Cash Register Company's Decimal Computer CRC 102-D." R. M. Hayes, A. D. Hestenes, L. P. Meissner, Electronics Div., National Cash Register Co.

"A Marchant Miniac Computer System," George B. Greene, Marchant Research Inc.

"Performance of the TRADIC Transistor Digital Computer," J. H. Felker, Bell Telephone Labs.

"Application of a Burroughs E101 Computer," Alex Orden, Burroughs Corp.

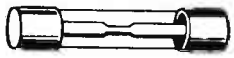
Panel, "Small Digital Computers and Business Applications," Chairman William D. Bell.

Panel, "Redundancy Checking for Small Digital Computer," Chairman Richard W. Hamming, Bell Laboratories.

Panel, "Small Digital Computers to Assist Large Digital Computers," Chairman, John W. Carr, III, Univ. of Michigan.

(*Continued on page 162*)

Why it's Good Business to Standardize on BUSS FUSES



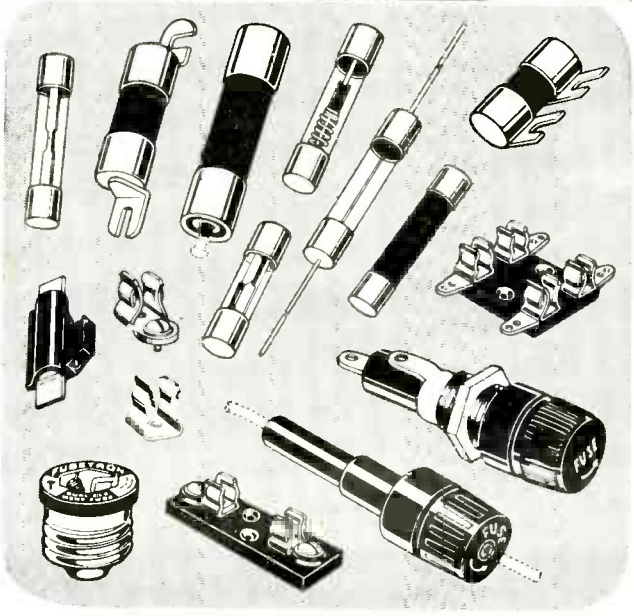
Manufacturers and service organizations in increasing numbers are standardizing on BUSS fuses because . . . they know, from their own experience, that BUSS fuses give dependable electrical protection under all service conditions.

In fuses, unfailing dependability is so necessary — for the fuse alone protects when there is trouble on the circuit. And just as important, a fuse should never give a "false alarm" by blowing needlessly.

To make sure that BUSS fuses maintain their 40 year old reputation for highest quality, every BUSS fuse normally used by the Electronic Industries is tested in a sensitive electronic device that automatically rejects any fuse not correctly calibrated, properly constructed and right in all physical dimensions.

Save designing time on new products.

When designing new devices that require electrical protection you can save engineering time by turning to BUSS. Our fuse research laboratory and its staff of fuse engineers can help you save time and money in determining the right fuse or fuse mounting for the job . . . and if possible, ones already available in local wholesalers' stocks.



Makers of a complete line of fuses for home, farm, commercial electronic and industrial uses.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

For More Information Mail this Coupon

BUSSMANN Mfg. Co. (Div. McGraw Electric Co.)
University at Jefferson, St. Louis 7, Mo.

Please send me bulletin SFB containing facts on BUSS small dimension fuses and fuse holders.

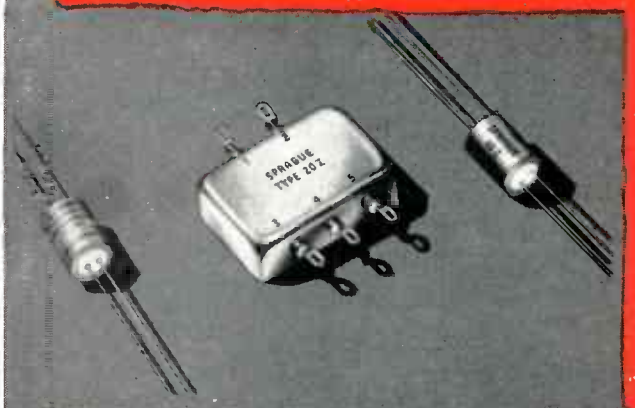
Name..... Title.....

Company.....

Address.....

City & Zone..... State..... TT-1254

Sprague PULSE TRANSFORMERS for digital computers



Type 10Z pulse transformer at left is color-coded to customer specifications. Unit at right is standard.

As a new line of reliable components for digital computers, Sprague has introduced and is in production on pulse transformers of a new type. This transformer line is principally directed to high speed, low power computer circuits, with some designs also finding application in blocking oscillator circuits, memory ring driving circuits, etc.

Two major types are offered: a miniature transformer, Type 10Z, for 0.05 to 0.5 microsecond pulse circuits, and a larger transformer, Type 20Z, for handling pulses up to 20 microseconds in length. Intermediate sizes and plug-in units are also available for special customer requirements.

Basic data on the high reliability miniature transformer is tabulated at right. Complete details are in Engineering Bulletin M 502. A copy will be sent you on letterhead request to the Sprague Electric Company, 233 Marshall Street, North Adams, Massachusetts.

Sprague, on request, will provide you with complete application engineering service for optimum results in the use of pulse transformers for computers.

BASIC CHARACTERISTICS OF TYPE 10Z PULSE TRANSFORMERS

Pulse Duration	.05 to 0.5 microseconds.
Applications	flipflop circuits • buffer circuits pulse amplifier circuits • gating circuits • other circuits with pulse lengths up to about 0.5 microseconds.
Physical Description	Hermetically sealed. Housed in corrosion-resistant can with glass-to-metal solder-seal terminals at each end. Can length is ¾″ and diameter is ½″. Transformers can be mounted and supported by lead wires in most applications.
Ratios Offered	Ratio 1:1 — Cat. No. 10Z3 Ratio 2:1 — Cat. No. 10Z5 Ratio 3:1 — Cat. No. 10Z4 Ratio 4:1 — Cat. No. 10Z2 Ratio 5:1 — Cat. No. 10Z1 Special Ratios Available
Maximum Repetition Rate	For a pulse length of 0.1 microsecond, pulse repetition rates up to 2 megacycles per second can be employed.
Pulse Amplitude	Normally used in circuits whose pulse amplitude varies up to 60 volts.
D-C Rating	Maximum working voltage, 300VDC. Flash tested between windings at 600VDC. May be life tested at 450 VDC between windings, 85°C, for 250 hours.
Temperature	May be operated between –55°C and +85°C. Higher temperature units available on request.
Insulation Resistance	20,000 megohms minimum between windings, measured at 25°C and 180 Volts DC.

WORLD'S LARGEST CAPACITOR MANUFACTURER

SPRAGUE

Export For The Americas: Sprague Electric International Ltd., North Adams, Mass. CABLE: SPREXINT

TELE-TECH
& Electronic Industries

O. H. CALDWELL, Editorial Consultant ★ M. CLEMENTS, Publisher ★ 480 Lexington Ave., New York 17, N. Y.

It's Later Than You Think!

We're losing the Scientific Cold War. We're throwing away our technological lead over the Soviet Union. We're jeopardizing our future survival.

Believe us, the editors are not being panicky or sensationalist in stating the case in such strong terms. There is ample evidence to justify such statements, and we have published these supporting facts as soon as they have become available. (See editorial, "Stop Wasting Engineers," Sept. 1954 *Tele-Tech & Electronic Industries*. Also, "Radarscope" items in this year's May, July, Aug., Oct. and Nov. issues.)

Despite these efforts, and those of other men in the engineering profession who appreciate the urgency of the situation, little information has been disseminated to the public. A notable exception is a recent front-page report in the *New York Times*, from which the following data is taken.

The Soviet Union has 175 technical schools at university level with a student body of more than 300,000. The U.S. has about 150,000 engineering students.

The Soviet has 3700 intermediate technical training schools with 1,600,000 students. We have about 1000 such schools with an enrollment under 50,000.

China has 150,000 technical students in higher educational institutions, and is graduating 25,000 persons a year from two-year engineering courses.

The threat to the U.S. high school science program—training ground for future graduate engineers—is ominous. College graduates trained for such teaching has fallen 56% in the last four years, from 9096 to 3978.

In Soviet secondary schools, 40% of the curriculum is devoted to science and mathematics.

Soviet professional engineering training is of high quality, and practically comparable to our masters' degree.

The Soviet produced as many Ph.D.'s last year as the U.S., but while our degrees were three-to-one in favor of the humanities, they had the same ratio in favor of science and engineering.

The U.S. has approximately 500,000 engineers and 200,000 other scientists. Russia has 400,000 engineers and 150,000 other scientists. However, as shown in the accompanying chart from the *Times*, with their tremendous rate of training, they will easily outstrip us in a few years.

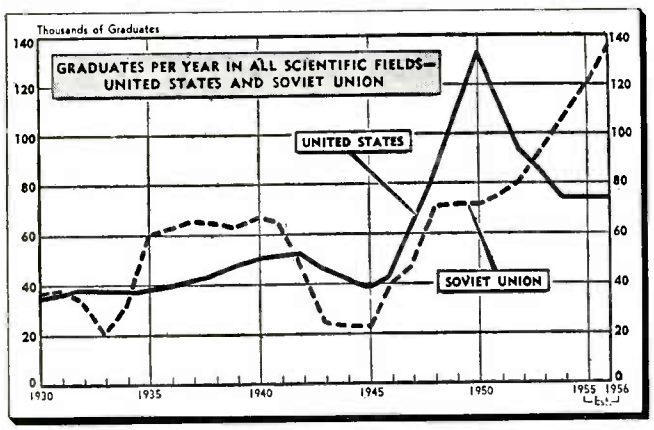
How to Meet the Crisis

In addition to encouraging young people in grade schools to enter engineering careers, the Soviet offer other important inducements. We can profit by their successful experience. Virtually all Soviet engineering schools offer five-year deferments, and sometimes even exemptions from military service. Scientific occupations are the highest paid in that country.

To increase our engineering manpower, we propose the following, and suggest that key engineers and executives in the electronic industries use their influence to encourage management and government officials to promote such efforts.

1. Intensive educational program to grade and high school students and their parents to acquaint them with the career opportunities in engineering.
2. Increased pay for high school science teachers.
3. Liberal draft deferment policy for college engineering students.
4. More generous industry-supported scholarships to promising science students.
5. Expanded program of federal grants to technical students.
6. Special government tax benefits to companies aiding future engineers.
7. Special educational encouragement to young women to enter the engineering field.
8. Maximum training and utilization of technicians to release engineers for more advanced work.
9. Higher pay for engineers and technicians.
10. Better consideration of scientists in regard to political and security matters.

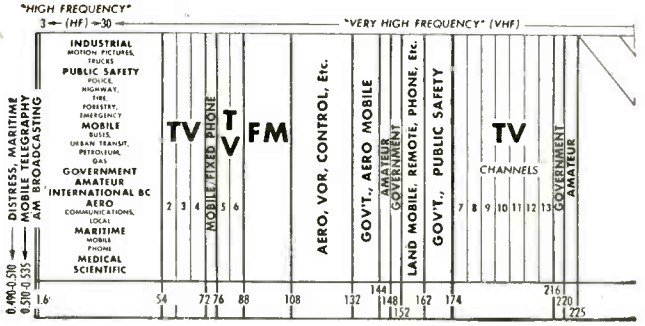
We can not stress too strongly the importance of initiating a bold program to increase our engineering manpower. The time is now, because it's later than you think.



Graph comparing scientific graduates in USSR and USA from 1930 to 1956. (From New York Times, November 6, 1954)

RADARSCOPE

Revealing important developments and trends throughout the spectrum for radio, TV and electronic research, manufacturing and operation



RESTLESSNESS and change mark the continued dynamic growth of the electronic industries as the end of 1954 nears. Eyes are focused on future course of industry patent pool. Number of medium-size defense plants are looking around for suitable commercial products. A large transmitter manufacturer is quietly up for sale. Status of fair trade laws is under anxious observation. Several non-electronic industrial giants are scrutinizing the field for a suitable point of entry. Shifts in advertising agencies are in progress. Mixture of caution and optimism accompany anticipation of rapid rise of color TV. All the searching and jockeying for position point to a year of stiff competition, significant expansion and aggressive selling.

GERMANIUM POWER RECTIFIERS are being pushed for the TV receiver market. General Electric reports that such units have several advantages over selenium types, including 10% higher dc voltage for a given input and immunity to ageing. Serious drawback for the original equipment market is higher cost of germanium rectifiers. Possibly this obstacle may be temporary and not affect the replacement market. In high-current magnetic amplifier applications, (above 1 ampere) where rectifier forward voltage drop is an important consideration affecting gain and efficiency, the claim is made that for a 130 v. rms germanium rectifier the drop would be less than 0.5 v.; for silicon about 1.5 v.; for selenium over 5 v.; and for gas tubes over 10 v.

NUCLEAR magnetic resonance spectroscopy, developed at the end of World War II, is finding increasing acceptance in the laboratory. In contrast with conventional spectroscopy, which relies on radiation emission or absorption, the new technique depends upon nuclear energy absorption when under the influence of stationary and modulated magnetic fields. It can recognize very fine differences between nuclear particles in a given specimen.

SUBMARINE COUNTERMEASURE

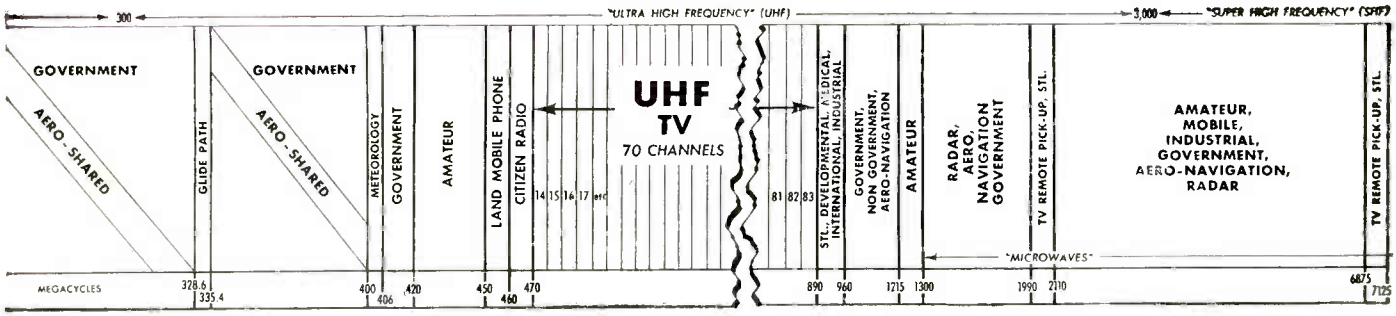
Stinger tail on U.S. Navy Neptune P2V-7 contains new electronic device capable of locating submarines hiding submerged beneath the sea. The Lockheed aircraft, called the "MAD-bird"—MAD standing for magnetic airborne detector—spots the subs by registering disturbances in the earth's magnetic field, and then lets loose with depth charges or torpedoes.

RADIO TARGETS

MODERN MILITARY AIR WEAPONS, such as guided missiles, radar controlled anti-aircraft guns and jet interceptor planes require modern targets for crew training. Inadequateness of targets previously used such as 200 mph towed sleeve targets, small radio controlled planes with gasoline engines, and obsolete planes converted to drone operation have been emphasized by recent gunnery tests. Small, swept-wing, pilotless jet planes, such as the Ryan "Firebee" are now being delivered to the Air Force, Army and Navy. These are able to fly about 600 mph at altitudes up to 40,000 ft. and are piloted from an electronic remote control on the ground. Since the cost of these units are approximately one-tenth of a converted piloted aircraft to a pilotless radio-controlled drone, and in view of our nation's constantly expanding air horizons, a new electronic industry is in the making.

RECORDING

MEASURING ENERGY and frequency of ocean waves is a topic receiving considerable attention of late from outstanding scientists and organizations. Recently Drs. S. S. Chang and W. J. Pierson Jr., N.Y.U. Research Scientists, reported a new electronic instrument for recording ocean waves on magnetic tape. A three-unit device consisting of recorder, playback unit and analyzer, it does in five or ten minutes the laborious and



error-susceptible mathematic computations previously requiring two weeks by hand. The instrument is not a computer, however, and costs only a fraction thereof. A pressure transducer FM modulates the on-shore tape recorder operating at 0.5 in./min. Playback then reproduces wave for permanent graphical recording. Increasing tape speed by about 4000 times permits obtaining a wave record spectrum. Fed into a filter analyzer the end product is presented as a function frequency for a 20 minute period and represents graphically the amount of energy at each wave frequency. Wave properties like surf beats and swell can be determined and thus permit accurate representation of the net effect of the waves on beaches, shore structures and vessels.

MICROWAVE COSTS

RECENT INDICATIONS by FCC to permit operation of privately owned microwave relay systems for television broadcasters has evoked some supporting comment from smaller stations. Generally it appears that privately owned systems can be operated at ⅛ to ⅒ the monthly cost of rental from AT&T, the common carrier. Short one hop systems cost about $16,500 initially and thereafter about $450 a month to operate. AT&T charges for monthly services are reported to range from $3500 to $4000. Such high monthly outlays are a burden for the smaller broadcasters, some of whom are already operating in red. There will be more on this topic in the near future.

ECONOMY

TECHNOLOGICAL EXPANSION is a must if we are to reap the benefits of our past gains and keep our economy strong, notes Dr. W. R. G. Baker. To do this we need a higher level of education, and educational TV is one means which can accomplish it. Outlining how the nation will expand, and provide new markets and opportunities, Dr. Baker noted that the U.S. population is expected to reach 184 million by 1963, a 15% increase over this year. This would mean 5 to 6 million new homes, millions more automobiles, TV sets and radios, and all other items required for modern living. Money spent on goods and services is expected to increase from $356 billion to $530 billion by 1963, and the money available for consumer spending or saving will increase from $252 billion to $365 billion.

RADAR AUTOMATION

CATCHING automobile traffic violators is only the first step in what is expected to become a definite pattern of civilian industrial applications of radar control. A good example of the second step is the integration of radar and computer controls in automatic yard controls, developed jointly by the Union Pacific Railroad and Reeves Instrument Corp., a Claude Neon subsidiary. The electronic yardmaster virtually eliminates impact damage to boxcar lading resulting from human errors. As the freight cars are pushed over the hump to descend down the incline to various tracks of the yard, a range-finding device determines how far the car must roll to couple with other cars. A radar meter measures the speed. All this data is fed to a computer which determines exactly how much the car should be slowed, and actuates braking devices on the retarder section of track, releasing it at just the right speed to roll perhaps ⅔ mile and reach the coupling point at 3 mph.

ULTRASONIC TOOL

Impact grinding by ultrasonic machine tool developed by Raytheon Mfg. Co. permits intricate shapes to be cut from hard and brittle materials, such as glass, ceramics and tungsten carbide, which were difficult or impossible to machine before. A 25 kc magnetostriction unit drives the brass or soft steel head a few thousandths of an inch up and down. Abrasive particles, suspended in a liquid which flows over the work in a continuous stream, are driven by the head, rapidly striking the work with forces up to 10,000 times their normal weight. This action does the cutting.

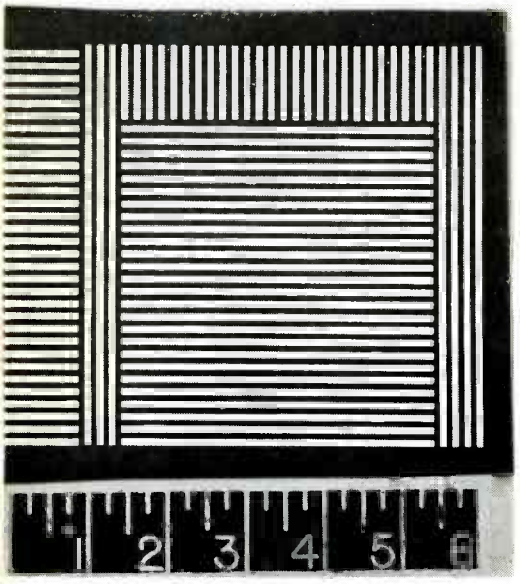


Fig. 1: Universal printed circuit board consists of pattern of wiring on one side which may be connected in a large number of combinations

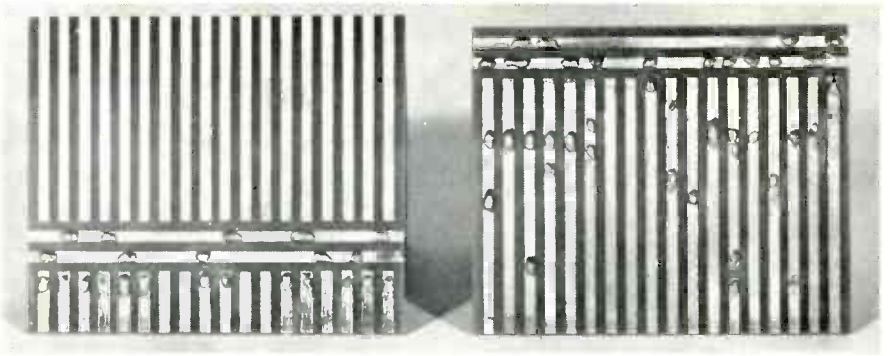


Fig. 2b: Printed wiring side of amplifier showing arrangements of breaks and solder points

A Universal

Time-saving standard board offers design engineers opportunity to try developmental circuits quickly

By J. R. GOODYKOONTZ
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SINCE its introduction the printed circuit has been considered to be suitable only for relatively large production runs. This is so because the cost advantage of the printed circuit does not appear until a certain critical production quantity is surpassed. A second reason, and this is more important from the viewpoint of the development engineer, is that the printed circuit may not be altered to accommodate circuit changes. Unfortunately circuit changes are necessary in the development stage and frequently in the early production stage also. This is especially true when a weapon such as a torpedo or guided missile is made. These devices cannot be adequately tested in the laboratory. Frequently the first model of such a device is built with the primary purpose of determining what circuit changes will be necessary.

Universal Circuit

For these reasons, and also because of the time it takes to get a printed circuit made, the utilization of the printed circuit during development is a burden. Yet it is not a good idea to use conventional wiring for development if printed wiring is contemplated for production. This procedure will save some time during the early development stages but makes necessary an eventual, complete redesign of the equipment. Thus very little is saved in reality; the time lag and cost are simply projected into the future.

But these difficulties may be avoided. To do this we have devised what we call the universal printed circuit. This circuit, designed to mate with a printed circuit connector, is shown in Fig. 1. As can be seen the circuit consists simply of a number of parallel wires which are fabricated onto one side of an insulating board. To adapt the universal circuit to a particular circuit it is merely necessary to cut the board down to the desired size, using that section of the circuit which most closely fits the application, break certain wires by cutting and peeling off wire sections and adding cross over wires on the component side of the board. In making the layout care is taken to keep the number of cross over wires at a minimum.

Shown in Fig. 2 is an amplifier which has been made using the universal printed circuit system.

Obviously if such printed circuits are stocked a considerable amount of time can be saved in putting together the first laboratory samples or prototypes of an equipment. An idea of the time saved can be gained from Table I. This table was made up from the records of all the printed circuit orders which the writer has made during the past two years. The table includes only the time between ordering date and delivery date and does not include drafting time.

The universal printed circuit, for all practical purposes, reduces this time to zero. In addition, the flexibility of the system permits circuit changes to be made with relative ease.

While the process of adding and subtracting wires on a universal printed circuit to adapt it to a particular circuit is ideal for laboratory and model shop applications it does not follow that the same system is best for production applications. Therefore in converting a particular design to production it would be desirable to fabricate the circuit boards with the subtracted wiring already

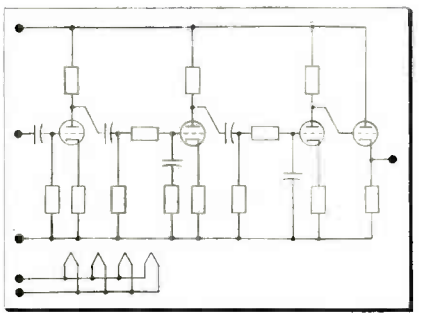

Fig. 2a: Circuit of amplifier shown above

TABLE I

Company	A 23	days	Company	B 34	days
"	A 57	"	"	A 6	"
"	A 13	"	"	C 28	"
"	B 31	"	"	C 23	"
"	A 17	"	"	C 40	"
"	C 47	"	"	C 23	"
"	A 19	"	Average	27	days

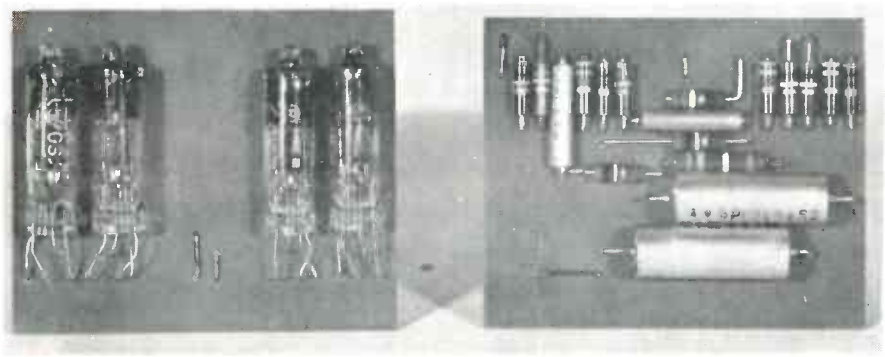

Fig. 2c: Reverse side of boards in Fig. 2b shows tubes and components connected to wiring

Printed Circuit

off and with the added, cross over wires printed on the reverse side. Electrical ties may be made through the board by means of plated holes or eyelets. Thus the production methods for circuits developed in this system would not be essentially different from the conventional methods now in use. In fact, if production is accomplished by automatic machines, the system is actually superior, since, due to the restrictions placed upon the component lead positions, the possible instructions to the machine would likewise be restricted, and therefore simplified, as compared to present systems in which component leads are randomly positioned.

No disadvantage of the system is seen other than the obvious one that it may not be convenient to modify the universal printed circuit to fit all applications. In this regard it should be noted that the circuit shown in Fig. 1 need not be considered a final and ultimate form. This layout was devised to apply to the problems of a particular laboratory. Other laboratories may find it to their advantage to alter this layout or to provide themselves with a number of layouts to fit the various types of circuits which they expect to produce. Foresight, generated by experience, will ultimately enable them to approximate their general requirements in advance and to provide themselves with adequate standardized circuits for their development projects.

Time Interval

It has long been recognized that the time interval between the conception of an electronic device and its production is too great. In fact for certain types of equipment, military equipment in particular, the interval is such that by the time the first shipment of a device is made the device is obsolete. It is believed that the process suggested here would in general reduce this time by about a month if no circuit changes are made. If circuit changes are made the time saved would be even greater.

Skeptics of course may view the process with less optimism. But even the takers of the dim-view will have to grant that the process will save some time, time which could well be used for something else. And this time is obtained without cost in quality, without making any new demands of skill or machinery, and without giving rise to a loss somewhere else in the long and difficult process of converting a thought into a finished, material product.

Printed Circuit Soldering Techniques

By FRED A. ANDREWS, JR.
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PRINTED circuit soldering is no different in principal than more conventional and better practised solder operations. Yet several difficulties are reported and for causes we can look for breaches of the most fundamental soldering precepts. Violation of the following maxims appear to be most prevalent:

(1) Surfaces to be soldered must be clean and completely free of metal oxides.
(2) The parts to be soldered must be as hot as the molten solder.

Close consideration should be given to the entire removal of the conductor pattern which has been printed or screened on the copper clad panel. This printing is done with a chemically resistant ink, the function of which is to resist the action of the acid etch. However, it will just as effectively deter the oxide removing duties of the solder flux. Unfortunately these inks have enamel, dried asphalt, or similarly inert bases which are insoluble in customary solvents and necessitate light mechanical abrasion for thorough cleaning. The decontaminated copper circuit is then, of course, subject to normal oxide build-up which must be flux removed prior to dip soldering. Strangely enough, however, soldering difficulties can more often be traced to this ink contamination than to inadequate fluxing. It is interesting to note that some manufacturers are dusting and rubbing printed panels in bins filled with granulated corn cobs. This not only acts to dry the boards subsequent to etching and rinsing operations, but also furnishes at least some of the gentle abrasive action required to remove the ink pattern.

One fairly accepted method for deterring excessive oxide build-up on clean panels when extended storage is required has been the dipping or hot-spraying of panels with parafin or light wax. This of course revives the necessity for cleaning prior to the actual soldering operation. Residual wax can carbonize at elevated soldering temperatures, and effectively impair the quality of the completed panel.

Electroplating

More prevalent has been the practise of electroplating printed circuits. The plated circuit is by no means an expedient for corrosion resistance only. A wide assortment of plating metals have been used with consideration to superior electrical contact, tougher wiping contact surfaces and other factors. However, electro-

(*Continued on page* 146)

Recent Developments in Silicon

A review of silicon-tin and silicon-gold junction characteristics. Silicon devices favored over germanium because of higher allowable operating temperatures and lowered diode back current. Fusion is means to mass production.

By R. A. GUDMUNDSEN, W. P. WATERS, A. L. WANNLUND, W. V. WRIGHT
Hughes Aircraft Co., Semiconductor Div., Los Angeles, Calif.

FOR the past several years the U.S. Signal Corps has sponsored research and development in the production of single crystals of silicon and silicon devices. Only about eight months ago, single crystals of silicon with sufficiently high perfection to allow transistor fusion research to proceed, were being produced.

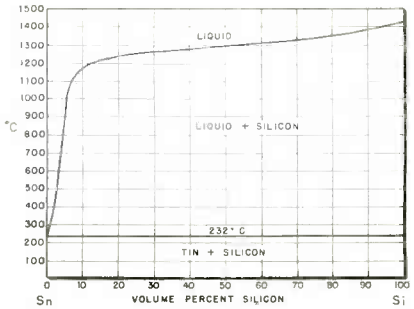


Fig. 1: Phase diagram of silicon-tin system

Before going into the results of the transistor research and development effort let us first examine two questions:

(1) Why a silicon transistor, instead of a germanium transistor?
(2) Why work on a silicon fusion junction transistor instead of silicon grown junction transistors?

From a material standpoint silicon is much harder to melt, i.e., it requires higher powered, more complex and expensive furnaces to process; it has the nasty habit of dissolving or sticking to almost any crucible material one can find. It is hard to purify chemically in the first place, and cannot be easily zone purified by the common methods. It has about ½ the electron mobility and less than ¼ the hole mobility of germanium. And silicon crystals have complicated heat treating properties in that the parameters change radically for the worse upon heating and exhibit trapping properties at room temperature which further complicate matters.

Band Gap

But, the band gap is 0.36 electron volts bigger, and when you raise e, the natural base, to the power $(KT/q) \times 0.36$ one gets a factor of about one million to play with, in the lowering of the diode back current from those of germanium devices. This means that much higher operating temperatures can be used, and at least a gain of four in the power per unit volume of device. The higher intrinsic resistivity, and better dielectric surface properties mean a considerable gain in the maximum operating voltages.

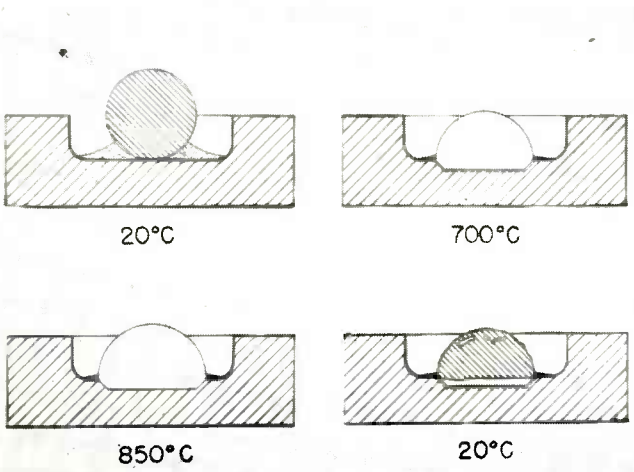
It is not uncommon to produce collectors with a back current (at zero emitter current) of 10^{-9} amps. at 100 volts. This is a nominal resistance of 10^{11} ohms. Of little importance now, but of possible importance in the future is the enormously greater natural abundance of silicon compared with germanium.

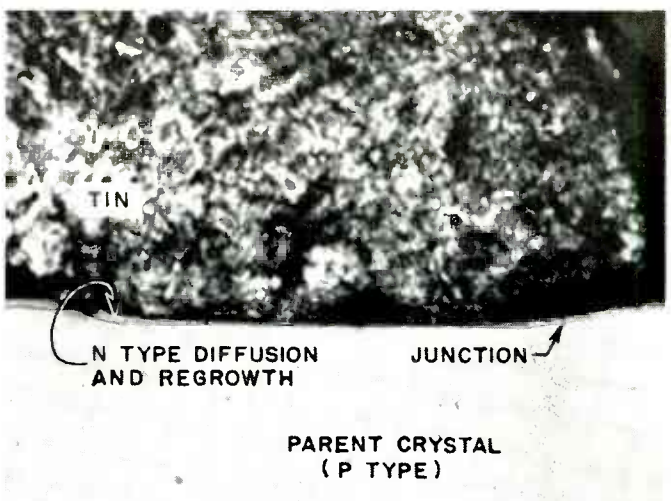
The answer to the second question, "Why a fused junction silicon transistor when one can make grown crystal transistors?" is somewhat less well defined.

First, the fusion process is a much harder process to develop, because of the complex metallurgy involved. There is a more critical need for crystal perfection and therefore more crystal research time is required. There are problems with the heat treating properties of the single crystal which must be reheated in the fusion process.

But, once these fundamental process problems have been solved, the fusion process is basically a mass production process as opposed to the drawn junction process, which is a laboratory technique extrapolated to production. We believe that the

Fig. 2: (l) Steps in using a solvent metal such as tin to form a fusion junction. Fig. 3: (r) Photomicrograph of typical silicon-tin fusion junction. Sample has been etched to bring out the junction line





Fusion Transistors

pattern followed in the case of germanium will also follow with silicon. That is, that the grown junction method will eventually supply only the most exacting needs, and that the work horses will be fusion units.

Structural features give certain inherent advantages to fusion units; these include such things as lower base resistance, and greater electrical symmetry for use in bilateral application.

Fusion Method

The fusion method is much more economical of high purity silicon crystal. One draw from a crystal drawing furnace yields about 10 times as many fusion units as can be made from one draw by the doping-pulling technique.

Fig. 1 is a phase diagram of the

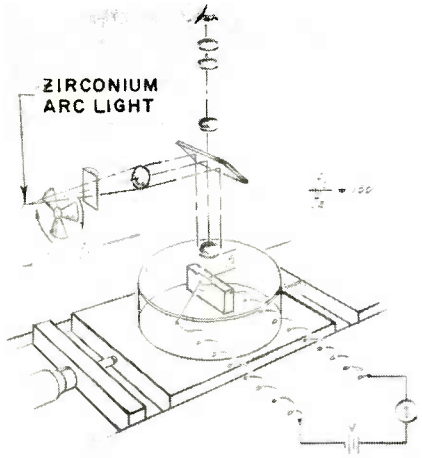


Fig. 4: Diagram of micro technique apparatus to measure lifetime degradation

silicon tin system. The important feature to note is the almost complete absence of solid solubility of tin in silicon in the solid phase. This means that if a liquid solution of silicon in tin were cooled slowly, the material which first precipitates out will be almost pure silicon with only a trace of tin as an impurity. If we should first add a percent or so of arsenic to the liquid solution and then cool, the silicon which precipitates out will be strongly doped n-type. Note that at 850° C tin will dissolve about 5% silicon by volume.

Fig. 2 represents the steps in using a solvent metal such as tin to form a fusion junction. In order to get through the silicon dioxide layer unavoidably present on the silicon surface, we can use one of several methods. One might choose a metal with an appreciable solubility for SIO_2 or second, abrade the surface to break up the film, or third, which is the one resorted to in the case of tin alloys, use a flux which forms a low melting glass with the silicon dioxide and melt it away. The flux in this case is a low melting alkali fluoride such as caesium fluoride.

The procedure is then to place the tin-arsenic alloy along with some flux on the surface and heat the sample. The tin first melts and forms a sphere on top of the flux. At about 850° C the fluxed silicon dioxide surface melts and allows the alloy to wet the surface and dissolve some silicon. After the solvent becomes saturated with silicon at 850° C, the fusion front comes to rest along an equilibrium position. However, the arsenic atoms are still diffusing into the solid at the interface, and convert the immediately adjacent region to n-type to a depth of about 1000 inter-atomic distances in a time of a few minutes. If we now cool the unit, the dissolved silicon will precipitate, and precipitation is always easiest on a seed; thus the majority of silicon "regrows" on the parent crystal as a continuation of the single crystal. Both the diffusion converted and the regrown region play important roles in the device properties. The dotted line represents the position of the p-n junction just beyond the surface of maximum penetration of the alloy.

Fig. 3 is a photomicrograph of a typical silicon-tin fusion junction. This sample has been etched to bring out the junction line. Note that the converted region is only about 0.0002 in. thick.

Special Problems

In principle, we now have a process which should be capable of making transistors; all we have to do is to make two fusions, one on each side of a thin slab of silicon. However, alas, there are a few problems still confronting us.

First of all, in order to have a good transistor, at least 90% of the emitted carriers must live long enough to diffuse to the collector. We thus try to make the base thick-

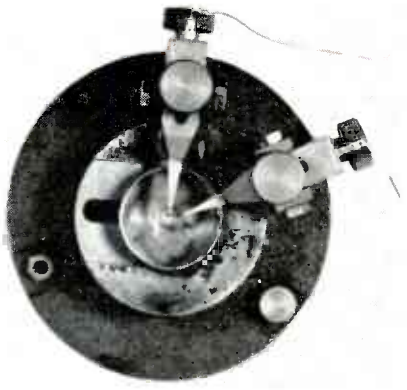


Fig. 5: Photo of specimen mounting jig

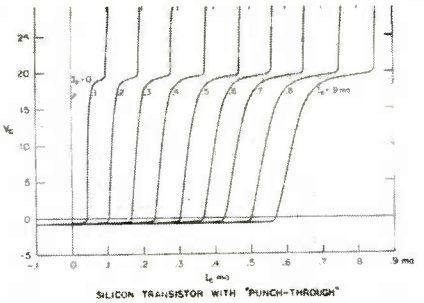


Fig. 6: "Punch-through" curve characteristics of a tin silicon fusion transistor

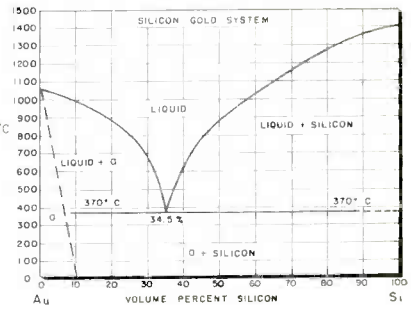


Fig. 7: Gold-silicon phase diagram

ness quite small, and to use silicon with a reasonably high minority carrier lifetime, which is defined as the average time an emitted electron lives in the base region before it disappears at a recombination center. However, when we heat the silicon crystal to 850° C. to perform the fusion operation with tin, the lifetime is always degraded, sometimes as much as two orders of magnitude.

In order to study the phenomena of lifetime degradation on actual fusion junctions to make sure of our ideas, a micro technique has been devised to measure the lifetime by injecting carriers with a thin line of light right next to the collector and measuring the junction current as a function of distance.

In Fig. 4 we see a schematic representation of the apparatus.

The basic instrument is a standard

Silicon Transistors (Continued)

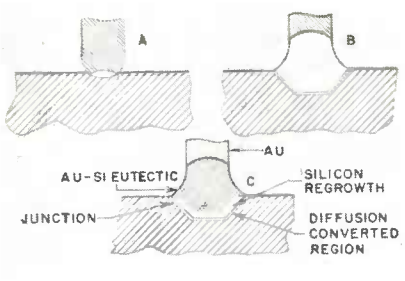


Fig. 8: Diagram of fusion mechanism

metallographic microscope with an oil immersion objective lens and binocular eyepiece.

Light from a 2-watt zirconium arc, which has a nominal diameter of 0.002-in. is chopped to provide a 45-cycle modulation, elongated into a line with a cylindrical lens, filtered to remove infra-red by a liquid filter, and projected through the microscope optics to form a line of light on the specimen which has been sliced and polished to the junctions.

Line of Light

This line of light has been made as thin as 3 diffraction patterns, and has a nominal length of about 0.1 mm. The specimen is mounted on a kinematic stage driven by a precision micrometer, and has a back lash considerably less than 0.0001 cm. Both photo voltaic dc measurements of photo current versus distance along the sample, and a special ac system utilizing a dc bias voltage, have been made. The ac system has been designed for very narrow band (about 1/50 cycle/second) detection, so that weak signals could be read in the presence of high noise.

Fig. 5 is a photograph of the specimen mounting jig. The specimen is first cast in lucite, sectioned normal to the plane of the junction, polished metallographically, and acid etched to remove the surface damage. It is then placed in this jig where contact to the alloy button and base is made with the probes.

By analysis of the resulting curves of photo response versus distance, one can determine what the actual diffusion length is in the sample and thus calculate the lifetime. It has been found that the tin fusions retain the same lifetime as bulk silicon does when heated to the same temperature, but this is so low that base thicknesses of considerably less than 0.001 in. are required to yield reasonable alphas. With reasonable resistivity material, these thin base regions often lead to a phenomenon called "punch through."

Fig. 6 shows a plot of a tin silicon fusion transistor exhibiting this phenomenon. Note the low value of dynamic collector impedance in the lower region; this is due to alpha rapidly changing with collector voltage as the space charge region of the collector reaches closer and closer to the emitter. Finally, as it touches the emitter, the emitter voltage rises sharply and follows linearly with the increasing collector voltage, differing from it by the voltage needed to maintain the space charge in the base region.

Extreme Thinness

Reasonably good transistors have been produced with the tin alloy, but the method is considered a brute force method where α is maintained by pushing the thinness of the base to an extreme. It is true that fairly high alpha cutoff frequencies can be obtained using this low solubility alloy.

Tin alloys are very soft, so stress and cracking problems have not been observed. However, the low melting point of tin limits the device to a maximum operating temperature of about 225° C. Further, the high chemical activity of tin produces some etching problems resulting in surface limited saturation voltages of from 50 to 70 volts.

A second solvent choice which we have is gold. Fig. 7 shows the gold-silicon phase diagram. This is known as a eutectic system, but still maintains the extremely low solubility of gold in silicon when in the solid phase. The mechanism of fusion in this case is quite novel in that neither primary constituent is anywhere near its melting point at the actual fusion temperature.

Fig. 8 illustrates the mechanism. Gold wire is pushed mechanically through the oxide film and comes in contact with the hot silicon surface, held at a temperature of about 450° C. Solid diffusion of each metal then begins to take place until a very thin film of material of eutectic composition is formed. This film melts, and dissolves both metal surfaces as liquid diffusion and convection proceeds. If the wire is now pulled away from the liquid, equilibrium will be reached. The thermodynamic potential of the system includes the crystal surface energy, and this fact can be used to good advantage (if the conditions are favorable) to determine the actual shape of the liquid-solid interface.

Crystal Planes

Fig. 9 shows this effect quite strongly. Notice the sharp geometric "crystal planes" which determine the interfacial shape. But one thing was quite wrong in this case,—this is the fact that on cooling, the temperature gradient was in the wrong direction, and all the silicon

(*Continued on page* 149)

Figs. 9 & 10: (l) Junction views of gold-silicon transistor. Fig. 11: (r) Section through transistor with alpha of 0.6 at 5v and 1 ma.

Page from an Engineer's Notebook

No. 29 — Printed-Circuit Capacitor Design

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A PRINCIPAL application of the printed-circuit or etched-circuit technique is the construction of high frequency filters or selective networks. In this application circuit

J. F. Sodaro

parameters are held to close tolerance and easily formed by the printing process. High frequency capacitors formed by this process are two plate units. One plate is printed on each side of the insulating board. The capacitance value is determined by the plate area, dielectric material, and board thickness. The capacitance in micromicrofarads can be calculated from

$$C = 0.2244 \frac{AK}{d} \qquad (1)$$

in which A is plate area in square inches, d is board thickness in inches and K is the dielectric constant. This equation gives capacitance slightly less than the actual value as a result of neglecting the fringing flux lines at the edge of the plates.

Using Nomograph

Insulating board thickness and material may be predetermined by mechanical rigidity requirements. Thus, the plate area is varied to obtain the required capacitance. The capacitor configuration may be square, rectangular, circular or any other shape of suitable area.

The nomograph shown in Fig. 1 may be used in the solution of eq. (1). Board dielectric constant is selected on the K scale and thickness on the d scale. These points are used to draw a straight line. The intersection of this line with the T scale establishes a turning point. A straight-edge pivoted on this point and intersecting scales A and C shows related area and capacitance values. The procedure is reversible. Thus, the chart can be entered on A and C to determine a pivot point on T on which a straight-edge may be rotated to give K and d values.

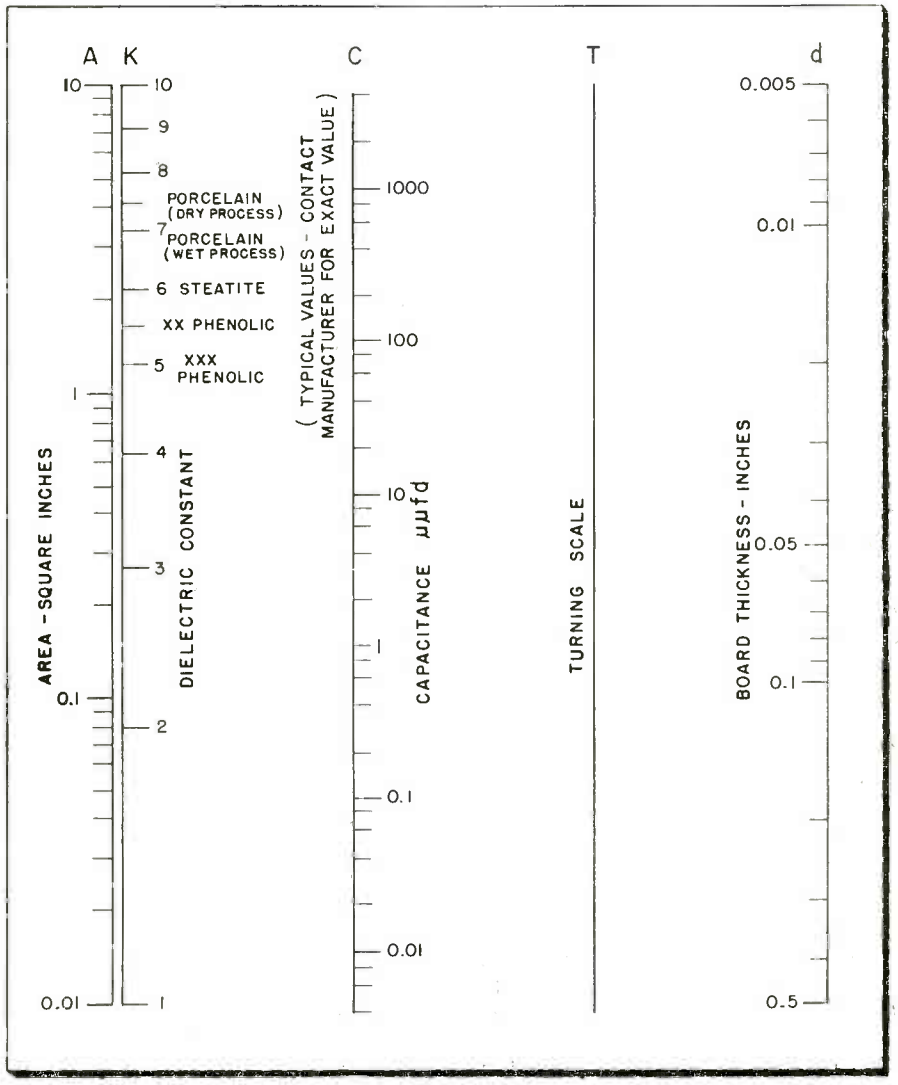
Practical Example

As an example determine the plate area required to give 9 μμfd. for a XXX phenolic board of 1/8 inch thickness. Construct a line from 5 on K to 0.125 on d to establish a turning point. Draw a second line from the turning point through 9 on C and extend the line to intersect A. At this intersection read 0.1 square inches as the required plate area.

Scale Multipliers

The K scale dielectric constant values may be multiplied by 10, 100, or 1000 if the answer scale is multiplied by the same quantity.

Capacity design nomograph for printed circuits



Limitations of Voltage Doubling

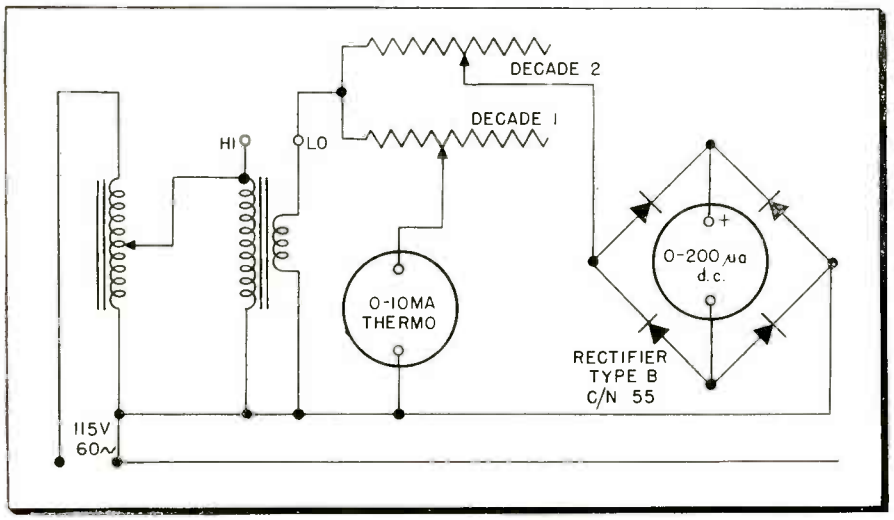


Fig. 1: Test set-up with thermo-milliammeter to obtain data on voltage doubling method

Basic shortcomings in military specifications applicable to rectifier-type meters result in serious difficulties when attempting to meet resistance criteria

THE voltage-doubling and half-scale methods of measuring the resistance of electrical measuring and indicating instruments is commonly employed when it is desired to accurately specify the resistance of a given instrument. Both methods require the use of a resistance decade connected in series with the instrument, the resistance of which is to be measured, and an adjustable source of dc or sinewave ac voltage together with a suitable dc or ac voltmeter to indicate the source emf.

The half-scale method is applicable to dc instruments. The decade is first set to zero ohms, and the instrument is deflected to full scale by adjustment of the source voltage. Then the resistance decade box is adjusted until the instrument deflects exactly half-scale, and the setting of the decade is taken as the resistance of the instrument. The principle limitation of the half-scale method lies in the fact that the half-scale graduation seldom conforms precisely to the electrical half-scale position of the pointer.

Instrument Pointer

In the voltage-doubling method, the instrument pointer is deflected to some easily readable scale-reference point, with the resistance decade set at zero ohms, by adjustment of the source voltage, which voltage is noted. Resistance is then set into the decade according to the estimated resistance of the instrument, and the source voltage is increased to exactly double that previously noted. The decade is adjusted until the instrument pointer again returns to the original scale reference mark, and the decade setting is taken as the resistance of the instrument.

As the Military specifies the voltage-doubling method as one of the criteria by which rectifier-type instruments shall be accepted or rejected, the instrument industry is experiencing great difficulty in producing low-range rectifier-type instruments, such as VU and DB meters, which will come within the allowable 5% when measured by the voltage-doubling method.

A search for the reason for failure of this method to indicate the resistance of low-range rectifier-type instruments has resulted in the conclusion that the resistance of any rectifier-type instrument cannot be accurately determined by means of the voltage-doubling method.

The circuit shown as Fig. 1 was set up in order to obtain typical results. All ac voltages were read at full-scale on the thermo-milliammeter by setting decade 1 on the basis of 100 ohms per volt including the 38.14 ohm internal resistance of the thermo-milliammeter in order to avoid any ac voltmeter scale errors. Both decades were within 0.1% of their indicated settings. The results actually obtained showed some slight errors which have been calculated out in Table I.

It will be noted that the errors and the rms current input are inversely proportional to the total resistance in the circuit, and that the apparent resistance of the rectifier-meter combination are in proportion to the total circuit resistance. Although the error drops to a negligible amount on higher voltage ranges, it is apparent that some small error will still remain regardless of the value of total resistance in series with the rectifier input. Therefore, the voltage-doubling method is not the supposedly precise method when applied to rectifier-type instruments.

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The clue to the observed inaccuracy of the method is found in the family of curves shown as Fig. 2, wherein A and C are curves plotted from the typical current-resistivity curve of copper oxide rectifiers vs. sinewave ac current and voltage respectively. Curve B is the familiar sine wave.

Reference Point

It is well understood that dc instruments indicate the average of the current flowing in the meter movement. In the foregoing tests, the reference point on the dc microammeter was at full scale, or 200 μa, which means that at any given applied voltage, the resistance in series was adjusted to result in an average of 200 μa from the rectifier and into the meter coil.

With 0.41 volt applied and only 13 ohms in decade 2, it may be safely

Method in Rating Instruments

assumed that substantially sinewave ac was applied to the input terminals of the rectifier. The waveform of the rectified current delivered to the meter, however, resembled curve C though it was modified somewhat by the 13 ohms and the resistance of the meter. It is obvious that the average value of curve C is much lower than that of curve B, and its relationship to the rms value cannot be the same as for a sine waveform. This will explain why the rectifier required an estimated 271.5 μa rms input current in order to deliver an average of 200 μa to the meter and to require an input potential of approximately 0.41 volt.

Doubling the voltage, i.e., adding 0.41 volt, required the addition of 1,627 ohms, which would indicate a current of substantially 252 μa rms, and also would indicate that the total resistance of the setup was 2 x 1,627, or 3,254 ohms. Actually the wave shape of the rectified output departed somewhat from curve C, tending toward curve B. The change in rectifier output waveform required in turn something less than 0.41 volt across the rectifier plus 13 ohms, and something greater than 0.41 volt dropped across the 1,627 ohms, which were added to decade 2, so that the actual rms current into the rectifier was something greater than 252 μa.

Output Waveform

As the voltage is doubled and redoubled and more and more resistance is set into decade 2, the rectifier output waveform departs farther from curve C and more nearly conforms to the sine of curve B. It can be assumed that with infinite resistance in series and with infinite voltage applied, the rectifier output waveform would closely conform to a sine, assuming of course that the input voltage was also of sine waveform.

At all points in the foregoing tabulation, the actual rms current is greater than that indicated by application of Ohm's Law to the voltage and resistance added to double for the reasons set forth above, and the resistance of the instrument as "measured" by the voltage-doubling method will always be greater than the actual effective resistance. The amount of error is of course inversely proportional to the total amount of series resistance. Thus the voltage-doubling method is apparently precise when working with high-range rectifier-type instruments, because the error is too small to be read on any meter. But the fact remains that even in such instruments, a small error is still present even though the most precise meters are employed in the measurement.

Another method might occur to some, wherein the voltage may be measured at the terminals of the ac instrument in question, and the result subtracted from the potential being applied through the decade.

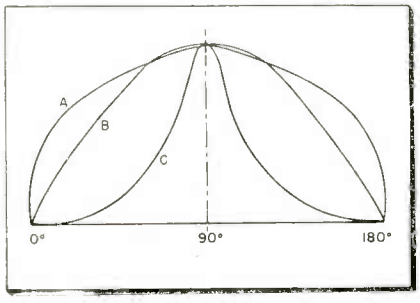

Fig. 2: Low-current curves are due to inaccuracy. A) Copper oxide rectifier vs ac sine current; B) Sinewave; C) rectifier vs ac sine voltage

This would give the voltage drop across a known resistance from which the rms current could be determined. This current divided into the observed voltage across the instrument terminals would then give us the effective resistance. In order to conduct such a voltage measurement, we must use a meter which draws substantially zero current, or in other words, a good laboratory model VTVM.

Consider from the above tabulation that our rectifier-meter combination, plus the 13 ohms in the decade, represents an ac voltmeter with a full-scale range of 0.41 volt, and that we wish to determine its effective resistance, which by the voltage-doubling method has been determined as 1,627 ohms at full scale. As with the voltage-doubling method, double the voltage to 0.82 volt and set the necessary 1,627 ohms into the decade. Then, measure the voltage across the 0.41 volt meter's terminals and read 0.43 volt. Subtract from 0.82 volt to find 0.39 volt as the drop across 1,627 ohms, amounting to 239.7 μa, which divided into 0.43 volt gives us as the resistance of the instrument, 1,794 ohms. The error of this method is largely due to the fact that the best VTVMs are essentially rectifier-type meters, and therefore can respond only to average values although they are precisely calibrated in rms values. When we read 0.43 volt, we were reading voltage of a waveform resembling curve A, the average value of which is obviously greater than that of the sine curve B. Curve A represents the rectifier input voltage drop developed by the flow of sinewave current. In this example, the average value of the rectified input voltage is greater, and that of the rectifier input current is lower than the 0.637 average value of a sine wave. Therefore, any attempt to determine the effective resistance of any rectifier-type instrument cannot help being in error to some degree when any form of rectifier-type instrument is employed in the related measurements.

Efforts to determine the effective

(*Continued on page* 142)

TABLE I

E	μa	Ra	Rt	Ri	Rm	Re	Rr/m
.41	x		13	1,510*	1,627	7.75*	1,510*
.82	252	1,627	1,640	3,254	3,364	3.38	1,614
1.64	244	3,364	5,004	6,728	6,843	1.71	1,724
3.28	240	6,843	11,847	13,686	13,800	.83	1,839
6.56	238	13,800	25,647	27,600	27,729	.47	1,953
13.12	237	27,729	53,376	55,458	55,579	.22	2,082
26.24	236	55,579	108,955	111,158	111,278	.11	2,203
52.48	236	111,278	220,233	222,556	222,678	.055	2,323
104.96	236	222,678	442,911	445,356	445,476	.027*	2,445

* Estimated only.

E is the sinewave source potential.
Ra is the resistance added to decade 2 when E was doubled.
Rt is the total resistance set into decade 2.
Ri is the resistance of the instrument as indicated by the voltage-doubling method (2 x Ra).
Rm is the resistance of the instrument as indicated by the addition to decade 2 upon doubling E.
Re is the plus error in percent of the resistance indicated by the voltage-doubling method over that previously measured before doubling.
Rr/m is the apparent effective resistance of the rectifier-meter combination (Ri minus Rt).
μa is the current in r.m.s. microamperes to the nearest whole number, omitting decimal frcations, determined by dividing the voltage added to double by the resistance added to double.

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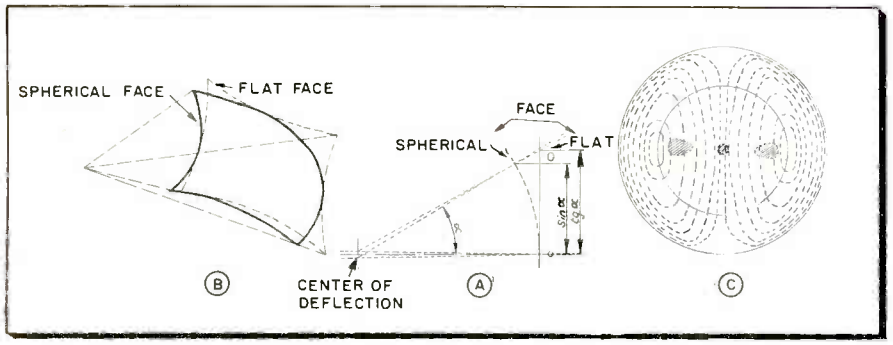


Fig. 1 (A) Spot distortion in flat-face tube with uniform field (B) Spherical and flat-face raster differences (C) Cross section of magnetic field in yoke on the neck of the picture tube

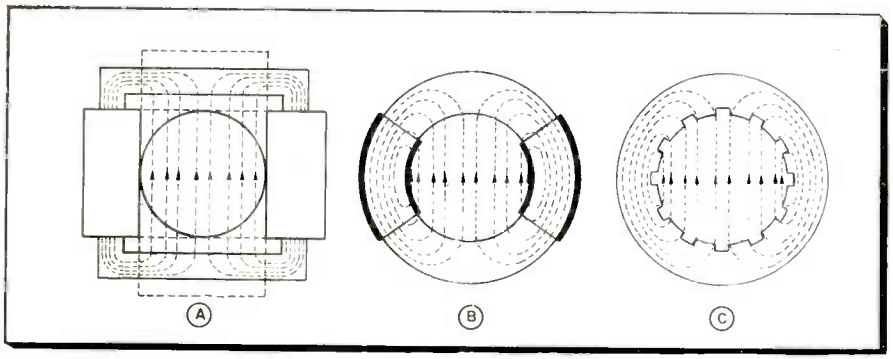


Fig. 2: (A) Using square or rectangular core is simplest way to obtain uniform deflecting field. (B) Ring core is better but requires cosine winding to restore field uniformity (C) More recent and still better approach is in castellated core

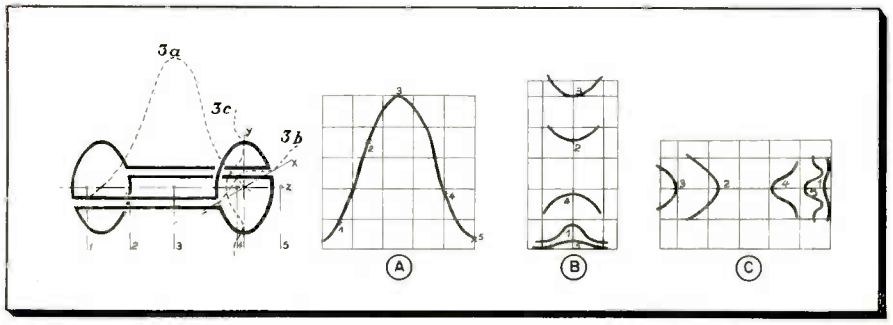


Fig. 3: Magnetic field plots of ordinary yoke in Fig. 2 (B) & (C)

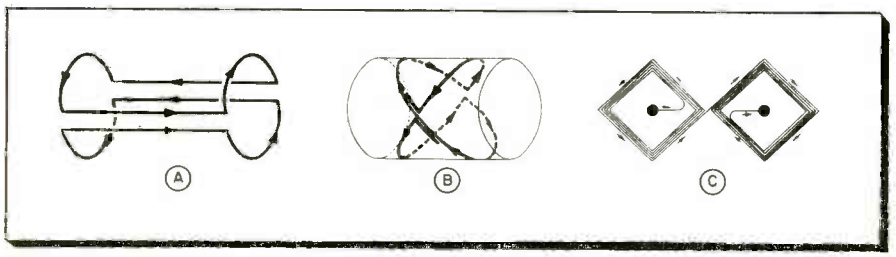
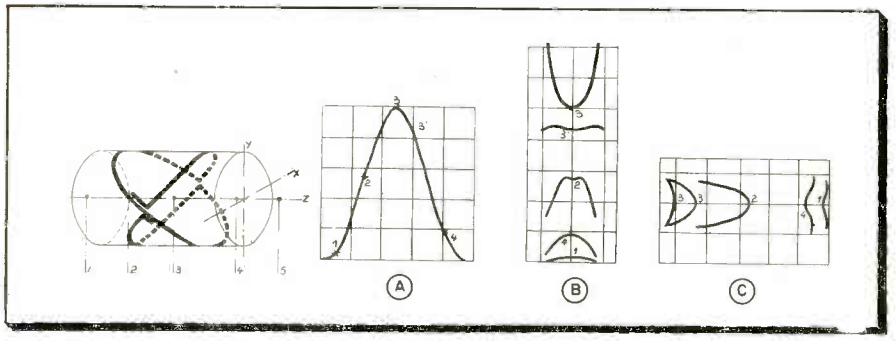


Fig. 4:(A) Usual shape coil cannot be entirely free from end-effects (B) Interlaced elliptical coils eliminate end-effects (C) Planar view of printed crossed-field deflecting coils

Fig. 5: Magnetic field plots for crossed field coils.



IT is a well known fact that the ordinary yoke falls short of the ideal in at least two respects, one concerning the geometry of the picture, and the other one its focusing. This is specially true with the more recent flat faced wide angle picture tubes, and this brings out another point becoming of greater importance: the efficiency of the yoke.

A high efficiency is very interesting since it alloys less powerful output tubes, and reduces the overall power needed by the receiver. It must not be forgotten that the current needed by the time bases represents easily half or two thirds of the total consumption of the receiver.

Geometric Distortion

When the screen of the tube is very nearly flat, a uniform magnetic field of deflection does not produce a uniform displacement of the spot (Fig. 1*a*). The sides of the screen being farther away than its center from the center of deflection, the length of the electron beam is greater off center and, for the same angular displacement, the spot moves a greater distance.

The difference between the rasters obtained on a spherical and a flat faced tube is shown in Fig. 1*b*. It is seen that, in the last case, the sides of the raster are bent inwards, and this peculiar form of geometric distortion is called "pincushion distortion."

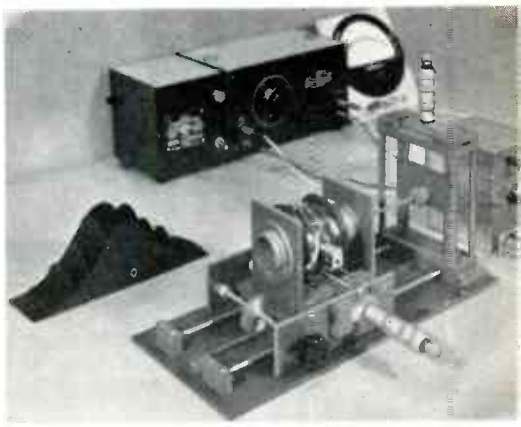
Uneven Focusing

Since all parts of the screen are not the same distance away from the center of deflection (Fig. 1*a*) it is immediately apparent that if the focusing is correct at the center, it will be incorrect near the sides. This is shown in Fig. 1a, where the beam goes through its minimum cross-section (point of focus) before it reaches point O on the flat faced tube.

Another cause of bad focusing is shown on Fig. 1c, and is due to the actual distribution of the magnetic field. Fig. 1c represents the cross-

Crossed-Field Deflecting Coils

Revolutionary new design by Visseaux Laboratories in France solves many of the problems associated with inexpensive and efficient TV deflecting yoke designs



Equipment used to plot magnetic field inside deflection yokes. Note 3D field model

section of the neck of the picture tube half-way along the deflecting yoke, and the shadowed surfaces show the shape of the electron beam at three different places. If this shape is round at the center, giving a round spot, it becomes oval on the sides and gives a distorted spot, and hence a bad focusing.

But the extreme positions of the beam inside the yoke correspond to extreme positions of the spot on the screen, and this kind of distortion, distinct from the first one, turns out to be also particularly annoying near the sides of the screen.

Uniform Field

The simplest way to obtain a uniform deflecting field is shown in Fig. 2a, using a square or rectangular core. It is not used much because it is too wasteful of energy, all the field not being concentrated inside the neck of the tube.

A much better way is to use a ring core (Fig. 2b), but in this case the field produced by an ordinary coil is not uniform, and the winding must be graded, according to a cosine law, to restore the field uniformity.

A more recent and still better way calls for a castellated core (Fig. 2c), the windings being inside the notches, either with the ends bent-up or in toroidal form. As previously, the winding must be graded to obtain a uniform field. The efficiency is the highest that can be obtained at the moment with this type of construction.

But, as we have seen, a uniform field is definitely not suitable with modern flat faced tubes, since it would give rise to a marked pincushion distortion.

This could be counterbalanced by an equivalent distortion of the opposite type, that is with the sides bent outwards. Such a distortion is called "barrel distortion."

From there springs the idea of producing a distorted field to compensate for the geometric pincushion distortion. For example, a uniformly distributed winding of the deflecting coils will produce a barrel field and a pincushion deflection, whereas a concentrated winding will produce a pincushion field and a barrel deflection.

Correction Computation

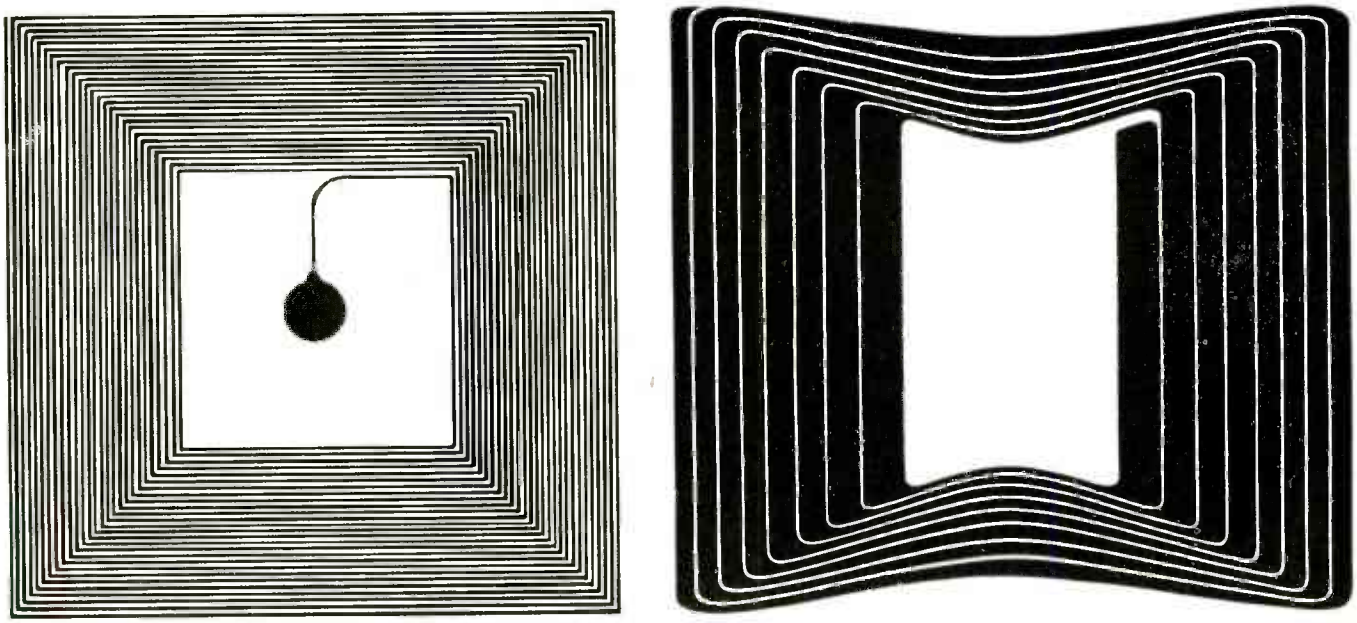
The exact amount of correction necessary for a flat faced picture tube can be computed with the help of Fig. 1a. The theoretical deflection on a spherical picture tube would be proportional to the sine of the deflection angle, whereas the actual deflection on a flat faced tube is proportional to the tangent of the deflection angle.

The field must increase when the angle of deflection increases; hence, it must be a pincushion field.

The necessary variation of the

(*Continued on page* 140)

Fig. 6: Close-up view of printed coils designed for crossed-field deflection applications. These coils without core give the same deflection as a conventional yoke with a high permeability ferrite core. Design also represents about a 25% improvement in circuit energy



Glow Transfer Tubes for Counting

Multi-element tubes employing principle of anode-cathode arc sequencing are finding applications in digital computers and radar equipment. Counting rates go as high as 4000 cps

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THE glow transfer tube is one of a number of counting tubes which have recently been developed, most of the development having been done in England and the Netherlands. The use of these tubes in counting circuits represents an important advance in the art of pulsing circuits.

There are a number of types of counter tubes, most of which are either cathode ray types, or the types which employ the mechanism of glow transfer. The glow types are further subdivided into the one guide unidirectional type and the two guide bidirectional type. The use of the two guide glow transfer tube in counting circuits will be described here.

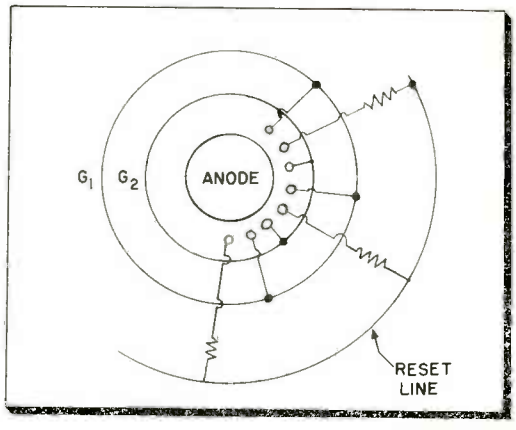
The glow transfer tube consists of a central disc, which serves as the anode, surrounded by a number of pins (30 for ten count tube and 36 for a twelve count tube), in a circular arrangement. For each count, the tube has a cathode pin plus two guide pins; i.e., a twelve count tube will have twelve cathode pins and twenty-four guide pins. Between successive cathodes there are two guide pins, each going to a separate guide bus. The tube is symmetrical about its center, so that if we start with any cathode K, and travel in a peripheral manner we find the following sequence of pins: K_1, G_1, G_2, K_2, G_1, G_2, K_3, G_1, etc. (This is illustrated in Fig. 1.) There is a resistor in each cathode circuit from which a signal may be taken.

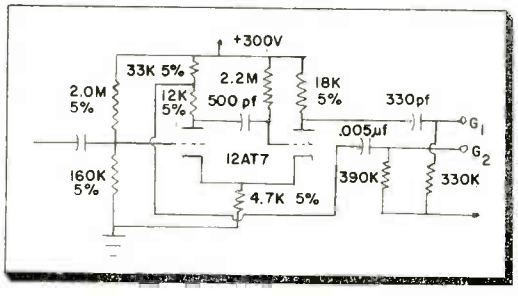
When the anode voltage is turned on, an arc is formed between the anode and one of the cathodes, the process by which the cathode is selected being a random one, since the tube is completely symmetrical and no external signals are applied. (The reason an arc forms to only one cathode is because the firing voltage is higher than the maintaining voltage, and therefore, once an arc is formed, the maintaining voltage assumes control and no other arc is formed.) To cause the tube to count we apply a negative voltage pulse of about 100 volts to one guide, immediately followed by another negative pulse on the other guide. This will cause the arc to transfer to the next cathode. If the order in which the two guides are pulsed is reversed, the tube will count in the opposite direction. Arc current flowing in the selected cathode causes a voltage drop in the cathode resistor, which thus gives a dc level at that cathode. The rise time of this dc level depends upon the rate at which the arc settles on the cathode. This is fast enough so that ac coupling with reasonably sized capacitors can be used.

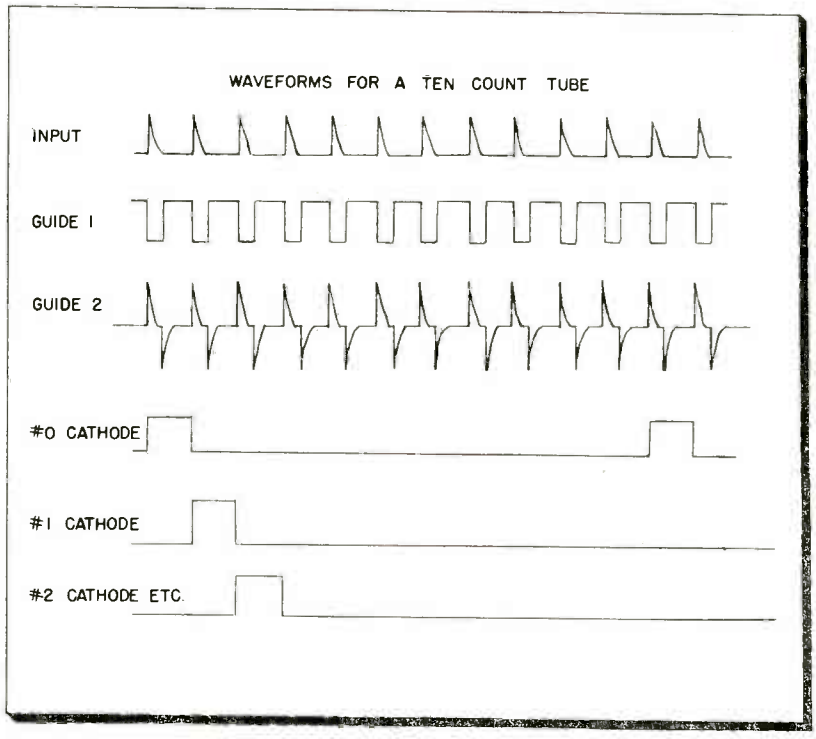
Operation

The mechanism of glow transfer occurs in the following manner: When a negative pulse is applied to guide G_1, the voltage difference between anode and G_1 is much greater than that between anode and cathode. The arc will then transfer to

Fig. 1: (l-upper) Basic structure of glow transfer tube consists of guide and cathode pins surrounding cathode. Fig. 2: (l-lower) Circuit for converting positive pulse to negative pulses to drive tube. Fig. 3: (r) Signal waveforms appearing at various points in circuit

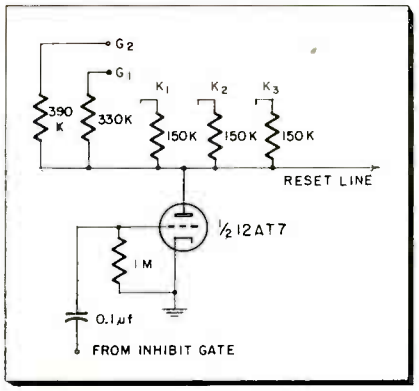






Circuits

the nearest G_1 pin. A negative pulse on G_2, following the one on G_1, then causes the arc to transfer to the next guide pin. This second pulse should immediately follow the first one. When the second pulse disappears, the guides will rise to a high voltage because of the guide current in the large guide resistors, and the arc will transfer to the nearest cathode, which will be the next one. Thus the tube has counted one count.



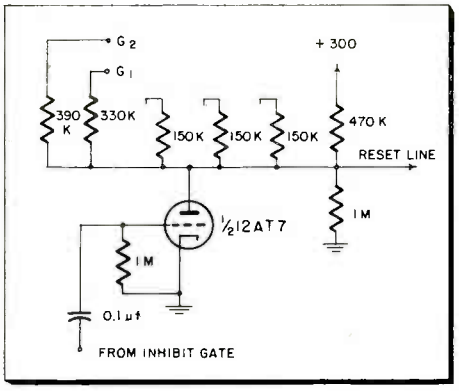


Fig. 7: (l) Reset with switch tube which cuts off when signal appears, allowing reset line to drift up. Fig. 8: (r) Similar "forced" reset switches 200 volts to line

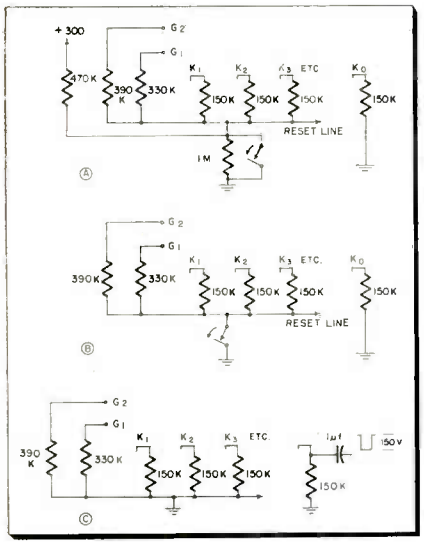


Fig. 4: Methods of accomplishing reset. (a) Positive voltage on reset line. (b) Floating reset line. (c) Grounding and negative reset

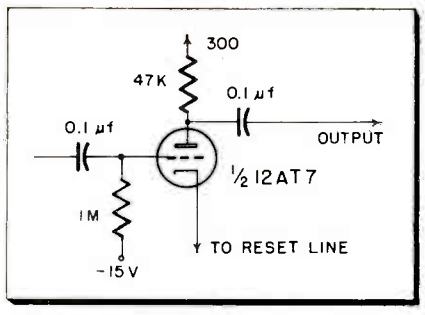
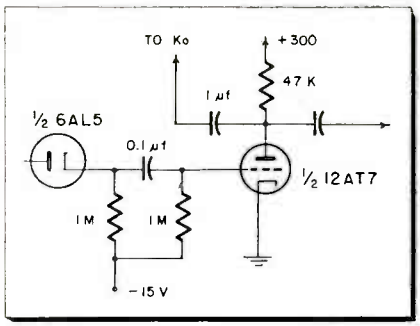


Fig. 5: Inhibit gate eliminates positive pulse

Fig. 6: Circuit for automatic resetting



A circuit for converting positive input pulses into the negative required to drive the tube is shown in Fig. 2. Essentially, it is a cathode coupled univibrator with outputs taken from both plates. The signal from the negative going plate is coupled into one of the guides through a large capacitor. The signal from the positive going plate is coupled through an RC differentiating circuit to the other guide. Fig. 3 illustrates signals appearing at various points in the circuit. The positive portion of the differentiated pulse does not affect the operation of the counter tube. The univibrator which has a pulse width of 500 μs is designed to give approximately 140 volts swing on each plate. This allows for a counting rate of about 2000 cps. Counting rates of 4000 cps can be achieved by halving the size of the timing capacitor. The tube is limited to a counting rate of 4000 cps because of the time required for the arc to transfer and settle. For slow counting rates, the tube provides a visual indication of the position of the count.

Reset Cathode

In addition to making the tube count, we can also cause it to reset at any time to any predetermined cathode. We shall hereafter refer to this cathode as the reset cathode or K_0. There are three basic methods of accomplishing this reset. They are:

1. By connecting all guides and cathodes, except the reset cathode through their resistors to a "reset line" (see Fig. 4a) and by causing a positive voltage to be put on the reset line, we see that since K_0 is much lower than the other cathodes, the arc will transfer to it.

2. A second method (Fig. 4b) similar to the first is to open the reset line and let it float. Now, all the guides and cathodes, with the exception of the reset cathode, since they are disconnected will drift towards the anode voltage. (This is a characteristic of the tube.) This upward drift in voltage on these elements has the same effect as applying a positive voltage to them, so that the tube resets.

3. The third method (Fig. 4c) is to connect all the cathode and guide resistors to ground and to apply a negative voltage to the reset cathode. This forces the arc to transfer to K_0 because its potential is lower than all the other elements.

Each method has its advantages and disadvantages. A consideration of the requirements will decide which method of reset is most suitable. The first two methods described above are similar in that both cause the reset line to rise above ground level, while the reset cathode remains close to ground level. (The reset cathode is above ground by the magnitude of the voltage drop in its cathode resistor.) The difference between the two methods is the speed with which the cathode resets. The drift reset requires approximately 0.1 second, while the forced method is considerably faster. The main disadvantage of both these methods is the fact that as the tube is reset, the reset line experiences a positive rise. Thus, the cathodes all experience a positive rise, and the output gets a positive pulse. This can be very objectionable; therefore, we must find a way to eliminate it.

Inhibit Gate

One way to eliminate this positive pulse would be to use an "inhibit" gate, such as the one shown in Fig. 5. The output signal from any cathode goes into the grid, and the cathode is connected to the reset line. If there is an ordinary signal on any

Glow Transfer Tubes (Continued)

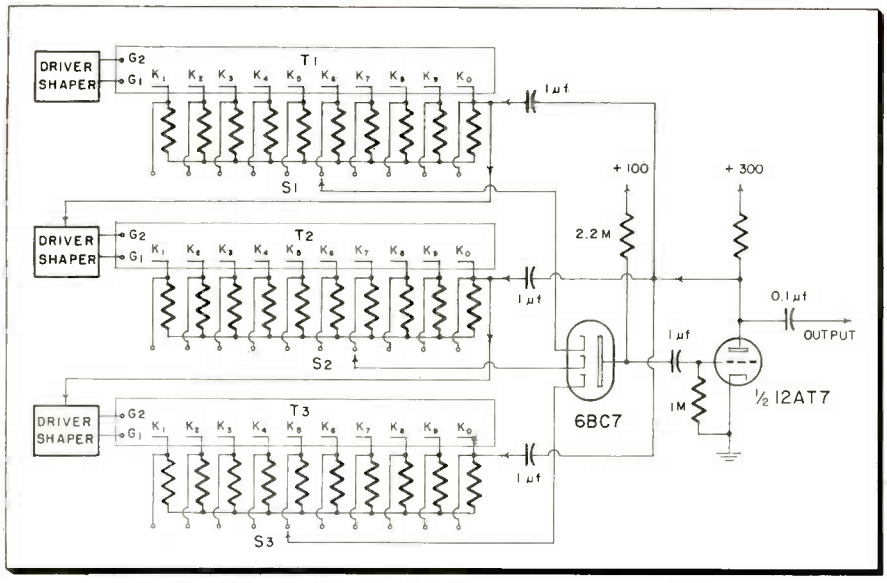


Fig. 9: Cascaded 10-count tube circuit for counting up to 1000

cathode, of the counter tube, the cathode of the gate, which is connected to the reset line, remains at ground potential, and the gate acts as an ordinary amplifier. However, during reset the cathode rises equally with the grid so that there is no output. The third means of reset described above was that by which a negative pulse is applied to K_0, in order to effect reset. Here we see that the reset line is permanently grounded, so that if we reset the tube, there is no extra pulse, and we do not need the inhibit gate. However, if we are taking an output from K_0, there will be a negative pulse in the output during reset. This can easily be eliminated by using a series diode in the output coupling circuit.

Automatic reset

It is possible to reset the glow transfer tube manually, by appropriate hand switching; however it will usually be required to reset it automatically in order to enable the tube to count to any number less than the maximum number. If no reset is used, the tube will count its maximum number and then begin over. For instance, the count will proceed as follows: K_{10}, K_{11}, K_0, K_1, K_2, etc. If it is desired to count to three such as K_1, K_2, K_3, K_0, K_1, we must reset the counter tube automatically when the count reaches K_3. A circuit for causing this reset is shown in Fig. 6. When a pulse from any preset cathode appears, the plate drops, causing a negative pulse to appear at K_0.

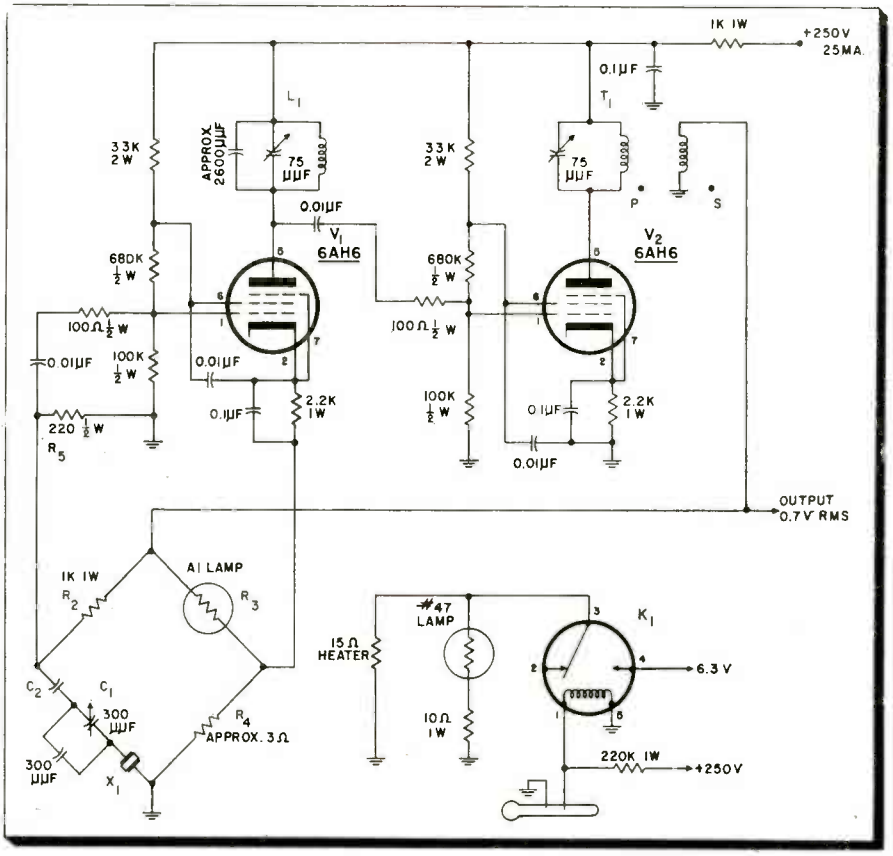
Circuits for effecting automatic re-

(*Continued on page* 153)

Subharmonic Crystal Oscillator

A SUBHARMONIC crystal oscillator circuit recently constructed at the National Bureau of Standards combines simplicity with versatility. The circuit requires only a single triode tube in a blocking oscillator circuit, coupled to a quartz crystal. Each output pulse of the oscillator "shock excites" the crystal, and the voltage generated by the crystal as it continues to vibrate or "ring" synchronizes the oscillator at a submultiple of the crystal frequency. With some crystals the circuit has been operated successfully at division ratios as high as 10,000 to 1, producing harmonic-rich output at 100 cps controlled by a 1000 kc crystal. The present circuit was a chance discovery of Dr. M. C. Thompson, Jr. of the NBS Sound Section, who, while working on a project sponsored by the Office of Naval Research, noticed that some equipment was oscillating in an unexpected fashion and proceeded to analyze and take advantage of the phenomenon. Although a search shows that a patent for a similar circuit was granted to W. A.

(*Continued on page* 161)



Subharmonic crystal oscillator circuit ►

Gain Stabilized I-F Transformers

Toroidal coils and boron-carbon resistors are combined in military aircraft application to produce amplifier with no gain change over 125°C temperature range

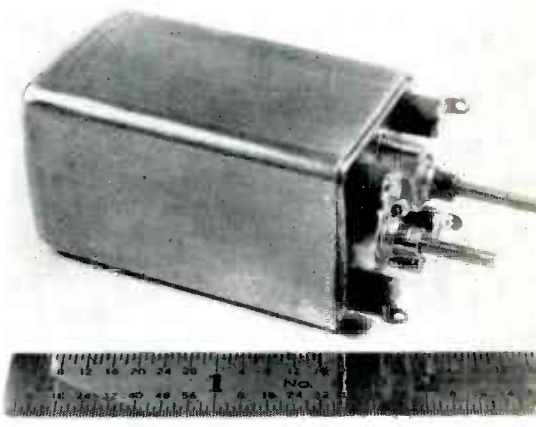


Fig. 1: Stabilized i-f transformer in can

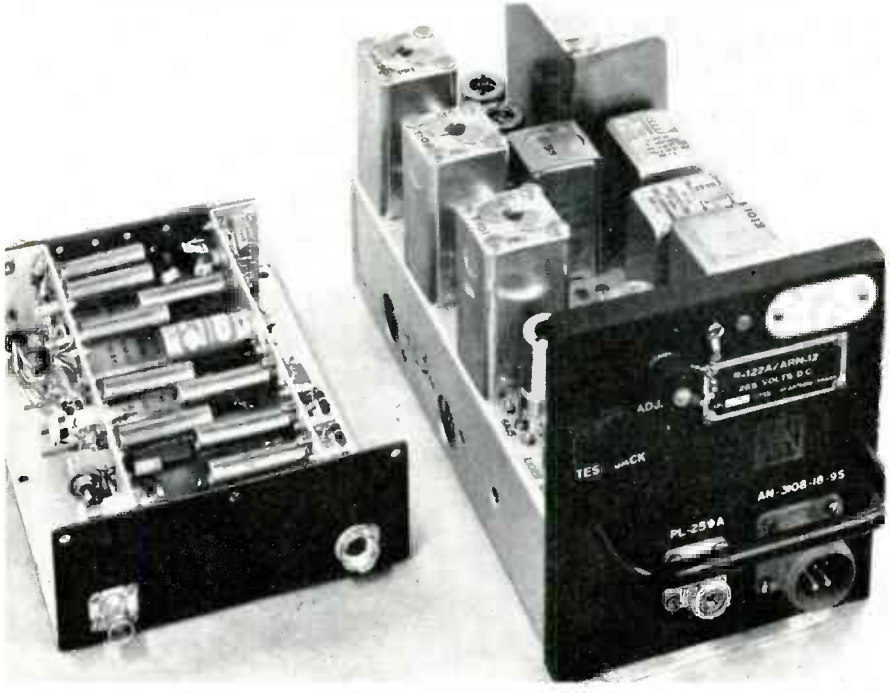
By JOHN F. CLEMENS
Project Engineer
Crosley Div., Avco Mfg. Corp.
Cincinnati, Ohio

IN many types of equipment fluctuations in the gain of a receiver are unimportant because of AVC and hearing characteristics. A 6 db change in gain, for instance, will ordinarily go unnoticed in a communications receiver. However, many automatic equipments such as direction finders or similar aircraft navigation aids are not nearly so tolerant in this respect. One of the cases which imposes severe requirements of gain stability is a Marker Beacon receiver. This aircraft navigation receiver operates by pulling in a relay when the signal reaches an arbitrarily set level.

We were given the task of developing a miniaturized Marker Beacon receiver for military aircraft. The miniaturized set which resulted is designated the ARN-32 and is equivalent in performance to its predecessor and prototype, the ARN-12. In Fig. 2 the two receivers are shown side by side with dust covers removed. On the right is the ARN-12 and on the left the miniaturized version, the ARN-32. The cubic volume, weight, and power consumption have all been reduced to ⅓ their respective values compared to the ARN-12. It was in development of i-f transformers for the miniaturized set that the problem of gain stability with temperature became important.

The i-f transformers developed are typical of transformers used in many equipments, and it is hoped that the techniques to be described which stabilized the gain may be useful to others who encounter this problem. The i-f frequency used in this set is 6900 KC. The i-f amplifier uses 3 transformers and the bandwidth at 6 db down is 140 KC. The coupling in this transformer is set at 90% of critical. The shape factor is 3.9.

Fig. 2: Comparison of miniaturized (l) and regular (r) marker beacon receivers



Q Requirements

The first i-f transformers constructed for the Marker Beacon receiver were of very conventional design. Both primary and secondary were wound on a common form with inductive coupling. Both coils were slug tuned. To obtain the desired shape factor it was necessary that the primary and secondary coils have Q's of 50. Since the Q of the winding itself was 60 to 70, a 68,000 ohm composition resistor was used to load the coils to the desired Q. After temperature compensating capacitors had been installed to eliminate frequency drift the transformers were evaluated. Several defects were discovered. Most important, the gain of each transformer increased by 28% as the temperature dropped from +50 to −50° C. In addition, the response curve which was symmetrical and single peaked at +50° C became unsymmetrical and double peaked at −50° C. The i-f amplifier using three of these transformers showed a 6 db gain increase as the temperature dropped 100° C.

Since the specification allowed only 3 db variation in sensitivity for the set as a whole from all environmental changes, including a 24 to 29 v. supply voltage change, it was obvious that the i-f transformers were completely unusable.

Drift Factors

The i-f transformers were analyzed in detail and their defects listed. It was found that the Q of each winding of the transformer increased by 23% as the temperature was decreased 100° C while the resistance of the loading resistor increased 6% under the same conditions. In addition it was found that

(*Continued on page* 136)

Design for a Printed Subminiature

Use of etched circuits permits simplification of i-f designs and resolves severe design parameters

By BERNARD RABOY & JOHN R. ENDICOTT, Electronic Design Engineers
The Glenn L. Martin Co., Baltimore, Md.

IT seems that most new designs for intermediate frequency amplifiers are the results of time-consuming trial and error development techniques. Each such new layout or modification raises its own problems of gain, band-width, size—and little value is salvaged from earlier effort. Recent Martin experience, however, suggests that i-f development can be simplified—and that, simultaneously, the most severe design parameters can be resolved.

Fundamental Parameters

Some parameters are fundamental to all good design. These include such goals as regeneration-free, stable operation, as adequate heat dissipation—and economy in development, manufacture and maintenance. There are others which are special to the individual device and to its expected service. In the development of a Martin subminiature, high-gain, radar intermediate frequency amplifier, this second set of criteria may be summarized as follows:

1. The amplifier was to deliver 115 db of gain with a 1.8 MC bandwidth centered at 30 MC, and was to incorporate 80 db of gain control.
2. The unit was expected to endure the combined environmental conditions of temperature, pressure and vibration which are encountered at high altitude. Specifically, it was to be designed to operate within a temperature range of —55° C to 80° C and to withstand shock and vibration forces of 10 G's.
3. Limited space was allotted, and this necessitated subminiaturization of the amplifier and of its tubes and other components.
4. The amplifier was to be designed as a basic configuration suitable for future i-f development.

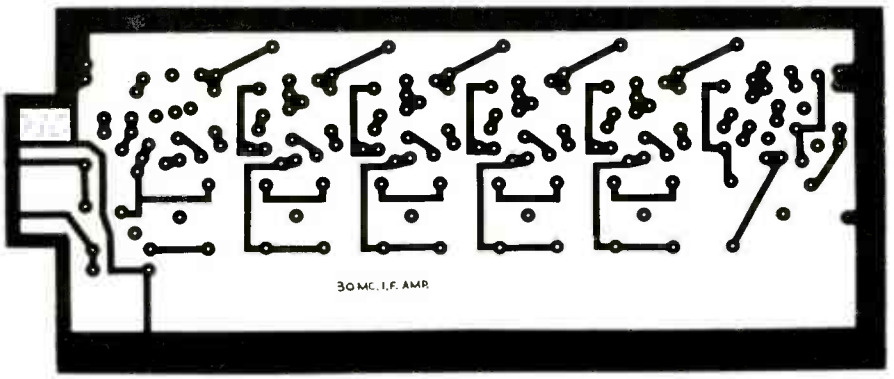
The techniques for elaboration of the Martin subminiature i-f amplifier and its components were resolved from these design parameters.

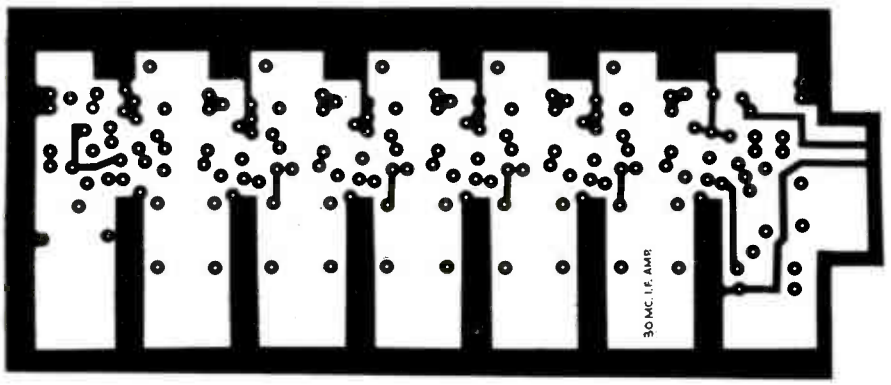
The etched circuit technique was chosen for layout purposes. A strip of fiber glass cloth, bonded with Epon resin, forms the base material. Then 0.027 in. copper is fastened to both its faces. This copper facing is etched away to delineate the circuit leads and connectors.

J. R. Endicott

B. Raboy

Fig. 1: Tape master for the top and bottom sides of the i-f amplifier etched circuit. Black tape of master masks areas of copper facing





An enlarged drawing of the desired "wiring" is made with black tape of proportionate width, as shown in Fig. 1. Doughnut-shaped pieces of tape are used for component tie points, and to these, eyelets are connected for reinforcement in the final assembly. The tape can be applied quickly and corrections are easily made.

The drawing is photographically transferred to the copper facing of the fiber glass base for etching. As illustrated by Fig. 2, both sides of the base were etched—because of the attending advantages in component placement and interstage lead length.

Components Used

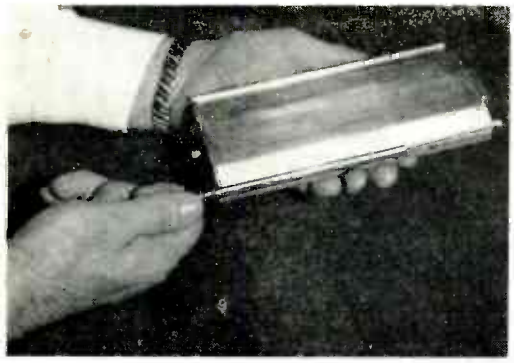
The severe environmental considerations dictated, in large measure, the selection of components. The tubes used were 5702 WA for the i-f stages—and 6111 was selected for the cascode low-noise amplifier.

Two types of resistor were needed.

I-F Amplifier

The ½-watt, carbon composition type was used for non-critical decoupling lines and the ¼-watt deposited-carbon type was selected for the few critical spots—such as tuned circuit-loading resistors—where wide resistance changes affect performance. In most i-f amplifier applications, however, the ½-watt, carbon composition resistors are satisfactory.

Because of space limitations, high K-type capacitors are the most suitable decoupling capacitors, although they exhibit large variations in absolute capacity with extended rises



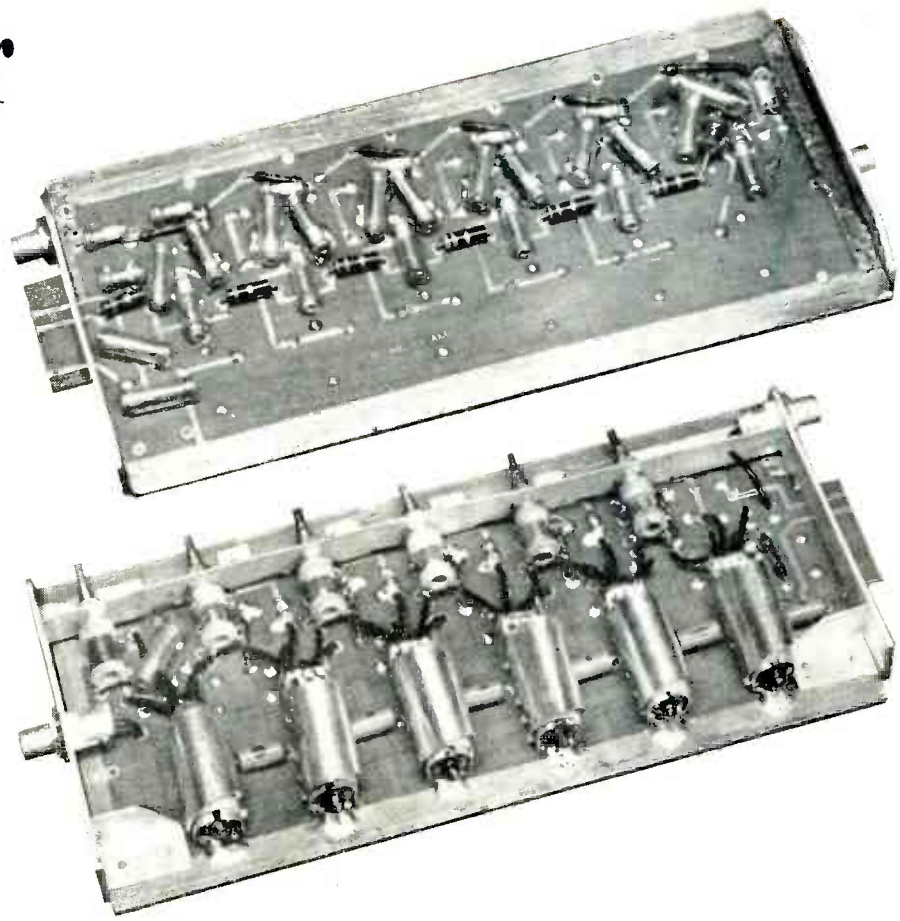


Fig. 2: (Above) Photo of both sides of seven inch unit with cover removed. Design features high reliability, simplified production and circuit uniformity. Fig. 3: (l) Cover plates are held together by sliding clips, not screws

in temperature. Such changes are greater than two-to-one in some cases. These components are small enough, however, so that capacitors of sufficient value can be selected to suit the anticipated temperature range without creating space problems.

The i-f coils were wound on commercially available coil forms. Bifilar windings were employed to eliminate interstage coupling capacitors. Wherever possible, standard commercial components were used. This obviated the use of costly coil forms and tuning slugs.

Because of the absence of circulating air, heat dissipation is always a serious problem in subminiature units. The only practical means for cooling appeared to be conduction to a large metallic area, or heat sink. This was accomplished in the design of the case and shielding. Spring fingers maintain mechanical contact from tube envelope to tube shield to outer case.

Each component has adequate spacing for accessibility. On one side of the etched base are arranged the tubes, tuning coils, loading resistors and filament decoupling chokes. On the other side are mounted the remaining networks: the grid, cathode and plate.

Sliding Clips

The case was designed to facilitate maintenance of the assembly, and therefore, the overall utility of the amplifier is enhanced. The case opens so that all of the components are readily accessible and the cover plates—as shown in Fig. 3—are held together by sliding clips instead of screws. These clips are stainless steel tubing which have been slit length-wise and opened to the proper aperture.

On examination, it can be seen that the parameters for a small, high-gain radar intermediate frequency amplifier were resolved in this design.

The prototype operated with no trace of regeneration. Only the normally prescribed precautions with regard to grounding and bonding were necessary. Shielding and filament grounds were made to a common point—and the plate, grid and cathode grounds were made to another.

The assembly is stable. Evidently, the spring fingers—intended as heat dissipators—assist in providing good electrical shielding. Critical grounding adjustments were unnecessary, and this was demonstrated by isolating the case with paper strips from the etched board.

Environmental tests were made to determine whether the heat generated by the amplifier tubes was adequately dissipated and to measure the operating temperatures of the unit's various components. These measurements are diagrammed in Fig. 4. At an ambient temperature of 25° C, the temperature of the outer case rose to 42° C. The hottest spots within the assembly were the tube glass envelopes. The base of the input 6111 reached 114° C and the interstage 5702 WA tubes stabilized at 103° C.

The air inside the case was recorded at 79° C, and this was the operating condition for most of the passive components. Any increase in the external ambient temperature, however, raises the temperature of the components proportionally—as they operate in actual service.

The amplifier has met the specific environmental standards by operating successfully at the specified

(*Continued on page* 151)

Transistor

100-cycle unit utilizes printed circuit construction, and provides accuracy of better than 1 part in 10,000 from -40° to 140° F

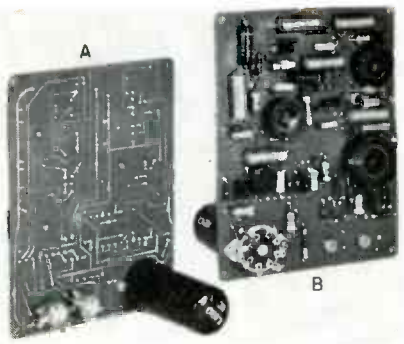


Fig. 1: Top & bottom views of printed circuit frequency standard show component arrangement

By J. H. SMITH, JR. & MARK CAMPBELL

Texas Instruments, Inc. 6000 Lemmon Ave. Dallas 9, Texas

THE most common method used in the exploration for oil is the comparison of reflections from the earth as the result of the explosion of a charge beneath the surface. This comparison is usually made by means of a multi-channel recording camera. The earth's structure is indicated by the time difference between reflections from the same structure as they arrive at evenly spaced seismometers. In order to accurately interpret this information, it is necessary that the camera timing markers be accurate to one part in 10,000. The timing lines are obtained from a tuning fork controlled motor.

Description

Figure 1-a and 1-b show the completed assembly which makes use of printed circuit techniques and miniaturized components including TI type 103 point contact transistors and TI 200 and 201 NPN junction transistors. The 8 KC crystal is a low activity unit with a series resonant impedance of approximately 25 K ohms.

The requirements for the frequency standard are that it be small, compact, reliable, capable of operating on low power and that it must have an accuracy of 1 part in 10,000 or better over the temperature range from −40 to +140° F.

The block diagram of Fig. 2 shows the counting arrangement. It consists of the 8 KC crystal oscillator and pulse forming amplifiers, divide by four counter and amplifier, and two parallel branch dividers which divide by four and five. The output from these two dividers (400 and 500 CPS pulses) are coupled into a coincidence type mixer transistor. The mixer circuit arrangement was used first because the frequency dividers did not operate satisfactorily at 100 CPS and secondly because of the fact that if either of the three divider circuits are malfunctioning the output frequency is so far removed from 100 CPS that it is quite obviously faulty. A grounded collector stage is used to couple the output of the mixer circuit to a low impedance galvanometer type recorder.

This oscillator circuit, Fig. 4, was used because the simpler one transistor negative resistance types of Fig. 3 will not oscillate with a low activity crystal. The equation for oscillation in Fig. 3 is

$$\alpha \geqq 1 + \frac{R_o}{R_L} + \frac{R_o}{r_c}$$

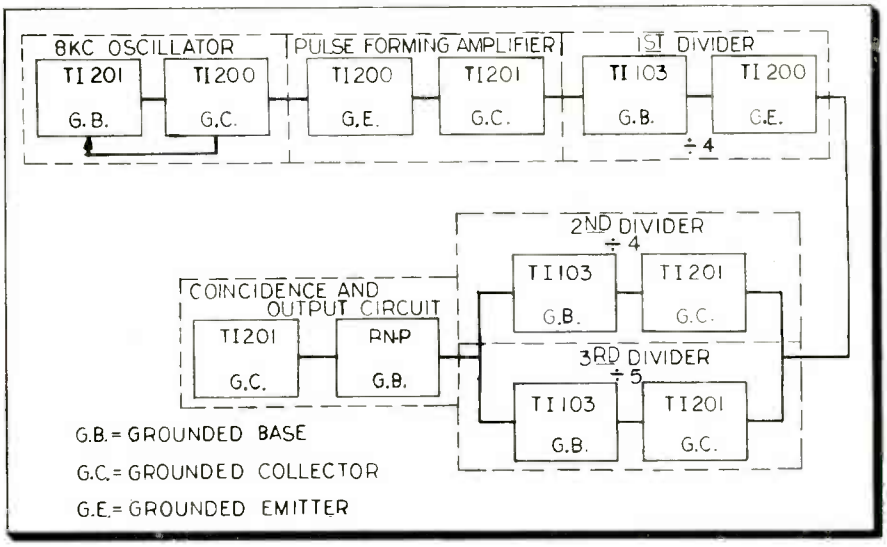


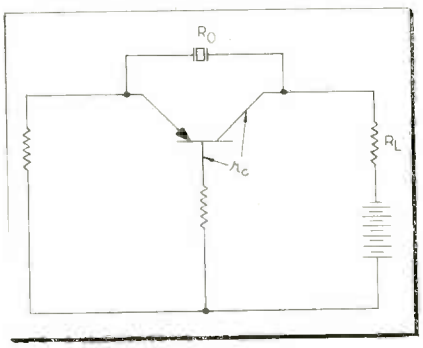
Fig. 2: Counting circuit with oscillator, dividers, pulse forming amplifier and coincidence circuit

Using typical values of 5 K for R_c, 25 K for R_o, and a large value for R_L, we find that α must be greater than 6, whereas the nominal value for α is 2 to 3.

In the circuit of Fig. 4, the voltage across R_L is low except at resonance. The full output current from the grounded collector stage is coupled into the input of the grounded base stage, and a current gain without phase reversal is obtained and the circuit will oscillate. Since the stages are considerably over-driven, the output can be differentiated directly to produce triggering pulses.

The output from the oscillator is coupled to the input of the trigger amplifier through a condenser (.001 mfd) which provides light loading and differentiates the waveform to produce trigger pulses. This pulse is amplified and inverted by a grounded emitter stage and coupled into a grounded collector stage which supplies the necessary power to drive the first divider.

Fig. 3: Simple transistor oscillator circuit



Frequency Standard

A major, but not insurmountable, problem associated with transistor low frequency standards is reliable operation of the frequency division mechanism. This problem is of little importance as long as the ambient temperature is relatively constant. However, field use requires operation under widely varying temperatures; in such circumstances, the transistor equivalent resistances may change several hundred per cent. Therefore, practical transistor dividers must employ an effective means of stabilization.

Some success was attained by using a special blocking oscillator circuit. The circuit that was finally decided upon is a modification of the simple astable negative resistance oscillator using a point contact transistor as shown in Fig. 5.

Collector Circuit

A capacitor was added to the collector circuit and the time constant of the collector and emitter circuits made the same order of magnitude. The emitter and collector circuit capacitors charge through the reverse resistances of their respective circuits, providing a slow exponential rise on the emitter and an exponential decay of collector voltage toward —12 v. During the process, a region of negative resistance will occur. When this happens, the capacitors discharge quickly through their respective forward resistances, producing a sawtooth wave similar to a vacuum tube relaxation oscillator.

Discharge of the capacitors carries the transistor outside the negative resistance region. The emitter and collector diodes are then biased in the reverse direction and the cycle is reiterated. The stabilizing effect is produced by replacing the base resistance with a high-Q tuned circuit whose resonant frequency is equal to the quotient frequency. These waveforms are also shown in Fig. 5.

The base circuit receives its energy from the pulse produced when the collector capacitor is discharged and

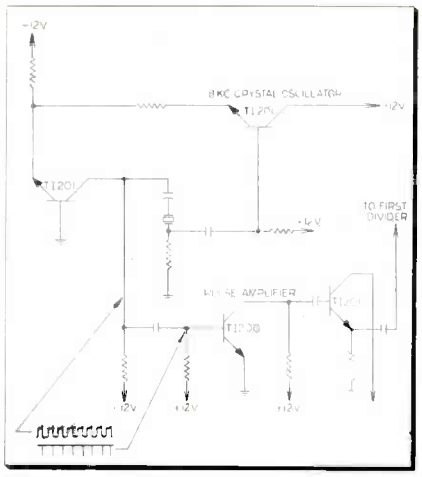


Fig. 4: Transistor circuit used which will oscillate with a crystal of low activity

will oscillate until a swing of the base sinewave in the negative direction coincides with a high positive going pulse on the emitter which drives the transistor into the saturation region. If the base sinewave voltage is large enough to primarily determine the free-running frequency, the stability of the circuit as a divider will be greatly increased.

In practice, then, it is desirable to make the sinewave voltage high by using a coil of sufficient Q with a tap about ½ or ¾ up from ground. Even with this excellent stabilizing feature, the free-running frequency tends to increase somewhat with temperature. Thus, a divide-by-four stage might eventually alternately divide by 4 and 3, and then continuously by 3; however, an increase in temperature reduces the gain in the uncompensated N-P-N junction pulse amplifiers, causing a decrease in pulse height. This latter effect compensates for the former. In one test, triggering pulses from the 8 KC oscillator were observed to decrease by 3:1 from room temperature to 145° F, yet the first divider continued to operate with no sign of instability. Fig. 7 shows typical waveforms of second and third divider when operating normally.

Pulse Variation

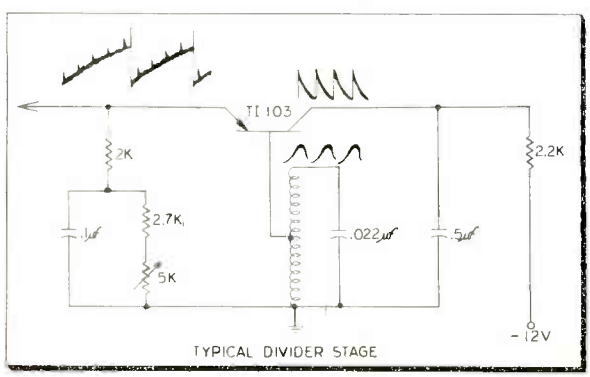
When the divider switches, it presents a radically different load to the grounded collector pulse amplifier, causing a variation in pulse height to appear at the input of the amplifier at the time of switching. Since the pulse amplifiers for dividers No. 2 and No. 3 have a common source, this variation will appear at the input and output of both pulse amplifiers and may cause unreliable division in both frequency dividers. A simple diode clipping circuit was placed across the input to the pulse amplifier which triggers No. 2 divider to equalize pulse height.

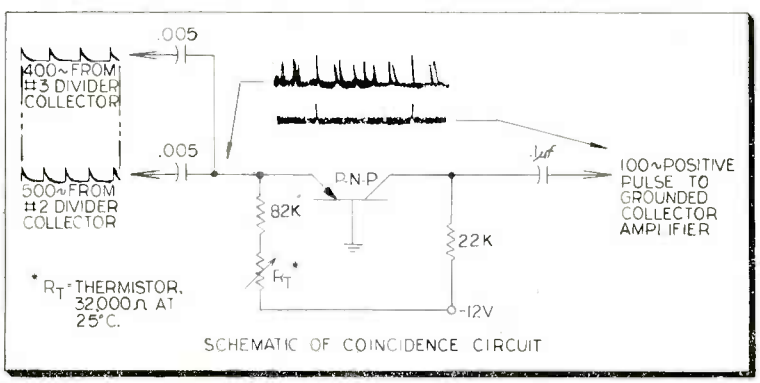
In Fig. 8B is shown a dual-beam oscillogram of the collector waveforms of dividers No. 2 and No. 3. The frequencies involved are 500 CPS and 400 CPS respectively. The arrows show where coincidence occurs.

These waveforms are introduced into the emitter of a grounded base P-N-P junction transistor as shown

(*Continued on page* 134)

Fig. 5: (l) Blocking oscillator provides stable frequency divider stage. Fig. 6: (r) Waveforms in transistor coincidence circuit





CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

$$$ FOR YOUR IDEAS

Readers are invited to contribute their own suggestions which should be short and include photographs or rough sketches. Typewritten, double-spaced text is requested. Our usual rates will be paid for material used.

CD Cluster Control Unit

EDWARD J. WHITE, 136 Woodlawn St., Chicopee Falls, Mass.

WHEN WMAS, Springfield, Mass., was designated as the cluster control (sequential operation) station, we were faced with the problem of building a unit that would control both the 640 and 1240 kc. frequencies. The drive unit is a 400 cycle selsyn converted for 60 cycle operation. Rotary switches #1 and #2 are wiping contact attenuators, with the stop pins filed down even with the contacts to allow 360 degree rotation. It is also necessary to insert an extra pin between the stop pins to provide constant contact with the wiping control arm through the 360 rotation. The contacts are strapped as indicated, and cross-connected. The more stations that participate in the clusters, the less cross-connecting will be necessary. Rotary switch #3 is a commutator segment alternator, and only one segment is used for circuit operation.

The switch (Ro/sw #3) kicks rotary #4 once for every revolution of the motor shaft. Rotary switch #4 is for the purpose of garbling the order in which the stations are tripped on and off. This switch is a 6 pole (one not used) 180 degree contact, 360 degree rotation. Relays Ry 1 through Ry 5 are 24 volt relays.

Interruption Reports

JOHN WHITACRE, Chief Engineer, WILS, Lansing, Mich.

THE F.C.C. requires that any interruption to the carrier or program be logged in the transmitter log. At WILS-AM we not only log it but also make out an interruption report, a copy of which is filed with the chief engineer and a duplicate with the program director. WILS-AM uses combination announcer-studio operators with the emphasis placed upon announcing ability. They are invited to hand out "gripe reports" to the engineering department concerning technical (equipment) trouble and inadequacies experienced. We usually note the trouble and take corrective steps while doing the studio weekly maintenance, unless it is really serious.

Push Button Switches

ARCH SLATER, CKOC, Hamilton, Ont.

PUSH buttons in consoles are usually multi-wired, depending on the number of actions desired, and it takes several hours to remove and tab all the wires soldered to the contact points. We clean and repair tensions on push buttons without taking off a wire. Dismantle the button deck by twisting the spade lugs, and lift back the top wired contact deck. Left out the slider slugs and dip in a solution of 3 oz. potassium cyanide and 1 pt. water (a smaller quantity mixture will clean all the contacts you have) wash off in water and wipe dry. Oil with a suitable contact cleaner and replace slugs, after cleaning and repairing the wiper points on the wired section. This solution also works on silvered platinum contacts, and can be stored and rewatered for use again.

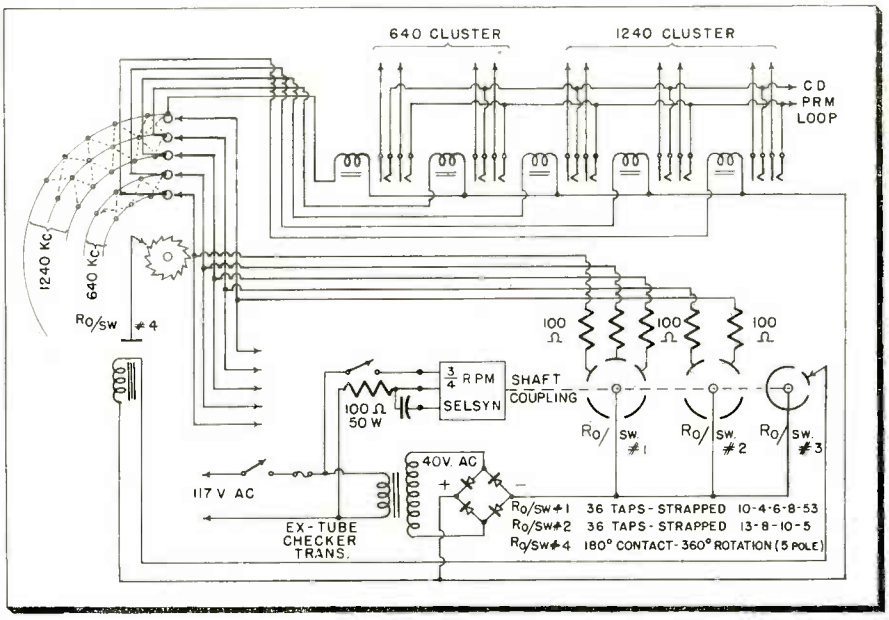
The whole job takes about ½ hour. Caution! Hands and parts must be washed after using cyanide, it is a deadly poison. The spade lugs won't stand bending too many times.

V.U. Meter Protection

PHILIP WHITNEY, Chief Engineer, WINC, Winchester, Va.

MANY types of electronic equipment, including the Ampex model 350 tape recorder, are so designed that the VU. meter is either mounted flat or in a sloping position. This has caused some trouble because of glass breakage on the meter. An operator who is busy loading a tape recorder can easily allow a tape reel to slip and break the glass, damaging the meter as well. Upon installation of several of these recorders at some of our stations, we made a simple and inexpensive protector for the meter.

A piece of clear plexiglass was cut to the size of the VU meter case, and cemented over the top, with holes drilled as to provide screwdriver access to the retaining screws holding the case in place. Some trouble was experienced with the loosened cement so subsequent installations were made by fastening the protective plastic plate on with "Scotch" tape. No breakage has been reported at any station since this safety measure was taken.



CD cluster control circuit employs selsyn drive unit to control 640 and 1240 kc

As an added convenience, we installed a tape splicer atop the housing containing the heads. The sloping panels would not allow the operator to place the splicer at any convenient position when working on the tape. Therefore two holes were drilled in the splicer and countersunk. Flat headed screws were used to fasten the splicer to the top of the housing, using the holes already provided to hold the housing in place. Therefore, the splicer is in the most convenient position for a quick splice job.

Anti-Fading Conelrad Alarm

ROBERT HOLT, Chief Engineer, KATE, Albert Lea, Minn.

WE use the Allied alarm amplifier hooked to the AVC of a Hallicrafters S-56 receiver. Being on the fringe area, our key station is subject to fading in the evening. This causes our alarm to trip often. The original Allied alarm 5000 ohm control is too large to permit critical adjustment when operating off a small change in AVC. Since making the following change we have not missed a single bi-weekly test alert and have not had one false alarm.

The Allied alarm can be used with either 15 second, 1000 cps tone actuation, AVC interruption, or both. We discounted the former as it was often tripped by certain musical selections, or static. Although not necessary, we removed all parts not associated with AVC operation (deleted from schematic). The original no. 2 relay was replaced by a more reliable 110V relay.

The buzzer is used as an external alarm in the studio hall. The control room signal is a 100 watt bulb with a wafer type blinker inserted in the socket with the bulb. These remain on until the alarm reset is depressed. In case the operator is in another part of the studio, we run our office and hall monitor buss through relay No. 2. When the alarm trips, it cuts the program off the monitor system and inserts our key station audio at twice our level. This not only alerts the operator but enables him to hear the Conelrad instructions no matter where he is. In the studio, the key station can be monitored on the control board earphones, or a special speaker.

3 Channel Remote Amplifier

W. W. BLAIR, WCMB, Harrisburg, Penna.

MANY radio stations have RCA Wire Recorders decorating their shelves because of the unavailability of the wire cartridges. Ours no longer collect dust on the shelves as we have utilized them in many ways; one is used as a disc cueing amplifier at our transmitter, one is used as an intercommunication unit for remote talkback at our main studios and one is used as a 3 channel remote amplifier, as described below.

The drive motor, speaker, bias oscillator and controls were removed and all unnecessary components discarded. A small V.U. meter with a fixed +8 db multiplier was installed in the speaker grille, and the volume control with A.C. switch was also moved up to the speaker grille. An isolated headphone jack was also installed directly below the V.U. meter.

A panel fashioned from an old aluminum disc with three Cannon XL receptacles mounted thereon was inserted in the front of the cartridge chamber. The front escutcheon plate was reversed and three Centralab Delta T Attenuators were installed in the positions formerly used for the tone control, function switch and volume control.

The old output transformer preamp was used as an additional filter choke, and a new output transformer was installed in the position formerly used for the drive motor. It should be noted here that because of the size of the motor opening in the chassis it was necessary to make an adaptor plate for the new output transformer. Only slight changes are necessary in the inverse feedback circuit for flat response from 30 to 15,000 cycles per sec.

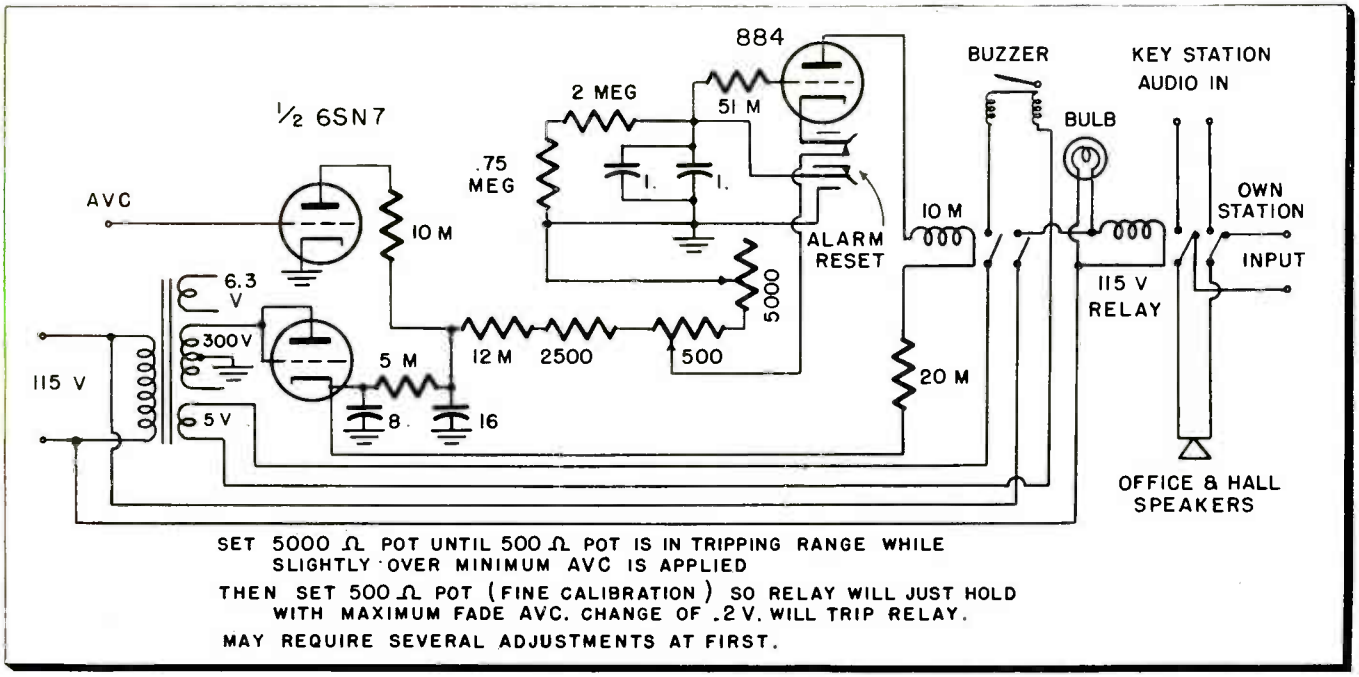
Converting Turntables to "45"

RICHARD W. JOHNSTON, WHRV, Ann Arbor, Mich.

WHRV has applied a conversion system to Fairchild Model 524 turntables, but it may be used on any unit that can be adjusted so that the table is uncoupled from the motor and gear drive. The Fairchild speed control knob operates through the center of the spindle on the turntable. When pulled up, the turntable operates at 78 rpm, and when pushed all the way down it rotates at 33⅓ rpm. Between the two positions the knob is in a "neutral" position, and

(*Continued on page* 106)

Anti-fading Conelrad alarm circuit consists of modified Allied alarm amplifier, external buzzer and control room bulb



Behavior of Electronic Equipment

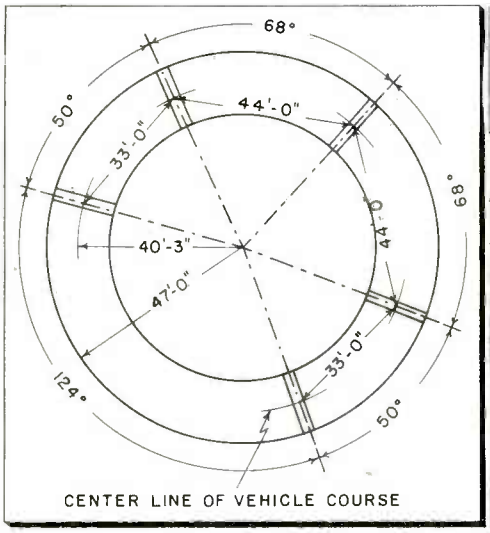


Fig. 1: (l) Sketch of circular test road. Fig. 2: (r) Circular test road with vehicle installed

Ruggedizing or shock mounting electronic equipment are prime considerations in assuring operational reliability. Circular test-track affords means of checking effectiveness. Package tester used as laboratory simulation facility

*By G. K. GUTTWEIN, F. K. PRIEBE, and S. M. JEE**
Signal Corps Engineering Laboratories, Fort Monmouth, N. J.

MOBILE military equipment is subjected to road irregularities and obstructions in the field. On many occasions, the exigency of the moment makes traversing rough road necessary. Consequently, failures of equipment and components may result. The elimination of equipment failures can be accomplished either by ruggedizing the equipment or by isolating the road generated vibrations and shocks. Ruggedization of equipment is not always feasible because of functional requirements so that the use of shock mounts is the only other solution. The selection of the proper mount is dependent on knowledge of the damaging frequencies.

Supplying the designer with pertinent data concerning the shock sources is the first step of a logical approach toward eliminating transportation damages. This information can be obtained through field tests in which samples of actual equipment are transported over rough roads until failure occurs. Since this type of investigation is not always practical for obvious reasons, it is desirable to simulate the field condition in the laboratory. The objectives of the test described are to measure the behavior of a military wheeled vehicle, electronic components and equipment, and shock mounts under rough riding conditions; and to investigate the performance characteristics of a commercial package tester, especially its applicability for simulating road shocks.

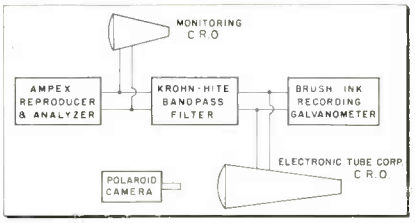
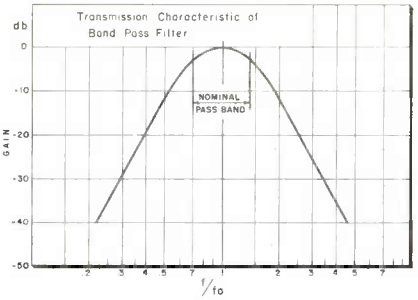


Fig. 5: Block diagram of equipment and circuitry used for frequency analysis

Fig. 6: Filter transmission characteristic

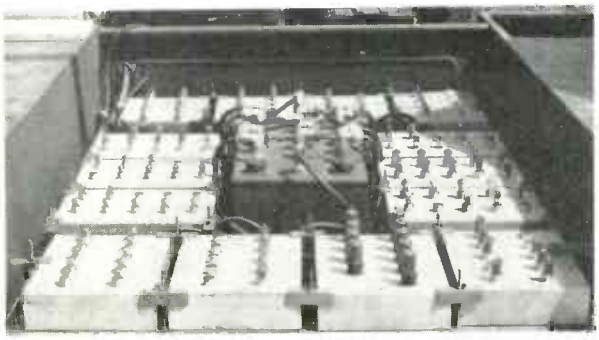


A test road, called the Circular Test Road, Coles Signal Laboratory, SCEL, was used to simulate rough riding conditions. Fig. 1 gives the dimensions of the test road and the location of the obstructions which consisted of 3 in. high chamfered planks with ½ in. felt function as the noise abatement material as visible in Fig. 2. The test vehicle used was a ¾ ton 4 x 4 truck; it was installed similarly as the ¼ ton 4 x 4 truck on the test course which is shown in Fig. 2. The ¾ ton truck, a permanent part of the test facility, is equipped with booms linked to the center piece where slip rings are located. Provisions are made so that the vehicle can travel the course at a constant speed (10 MPH for the subject tests) unattended.

Fig. 3 shows the type of mounting arrangement used for the electronic chassis. The chassis was fastened to the mounting bracket which, in turn, was bolted onto the cargo space of the truck. The test chassis were chosen arbitrarily from the stock pile; chassis of different weight and

**Mr. Jee is no longer with SCEL*

in Vehicular Transportation



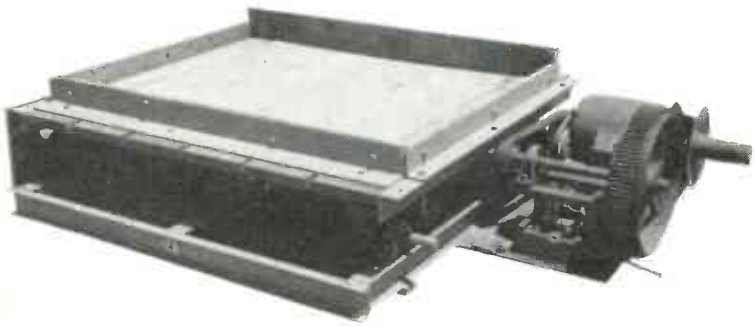


Fig. 3: (l) Method of mounting electronic chassis. Fig. 4: (r) L.A.B. package tester

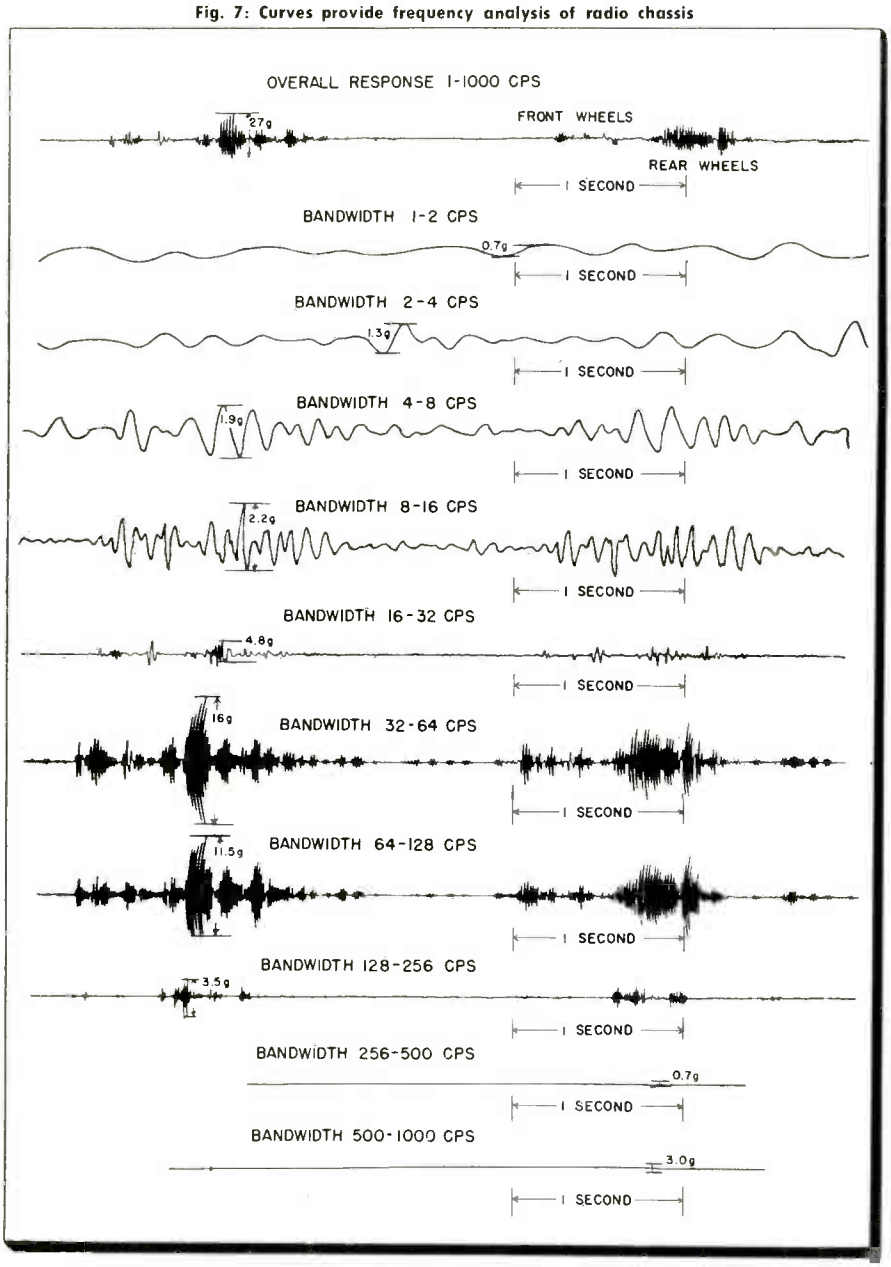
size were used. During the test runs, no electronic tubes were mounted on the chassis. The acceleration of the chassis and of the main truck frame was measured at various locations. In addition to the chassis, a complete piece of electronic equipment in the form of a meter tester was tested with and without a transit case. The inside package, measuring $11\frac{5}{8}$ x 16 x $9\frac{15}{16}$ in., weighed 43 pounds.

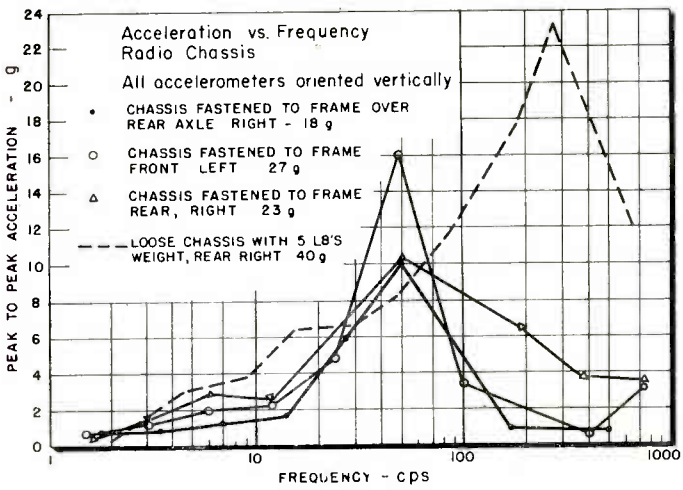
A L.A.B. Package Tester, Type 1000-D, as shown in Fig. 4, constituted the laboratory simulation facility, and an 80 pound backstop was the only addition made to the factory model. The table vibrates with a circular motion in the vertical plane. The equipment to be tested rests loose on the table. The vertical motion of the table causes the equipment to bounce up and down at least once during each revolution. Two table speeds, 240 and 285 rpm, were used for the test.

Instrumentation

Barium titanate accelerometers, Gulton type A410, were used for measuring the accelerations at various locations. The accelerometers were connected to an eight channel Ampex tape recorder, especially designed and built for shock and vibration work. The overall system consisting of accelerometer, recorder and reproducer has a frequency characteristic which covers the range from 1 cps to 1000 cps. The method of recording the shock and vibration phenomena under investigation on magnetic tape has the advantage that the tapes can be reproduced many times in the laboratory and the evaluation and analysis of

Fig. 7: Curves provide frequency analysis of radio chassis





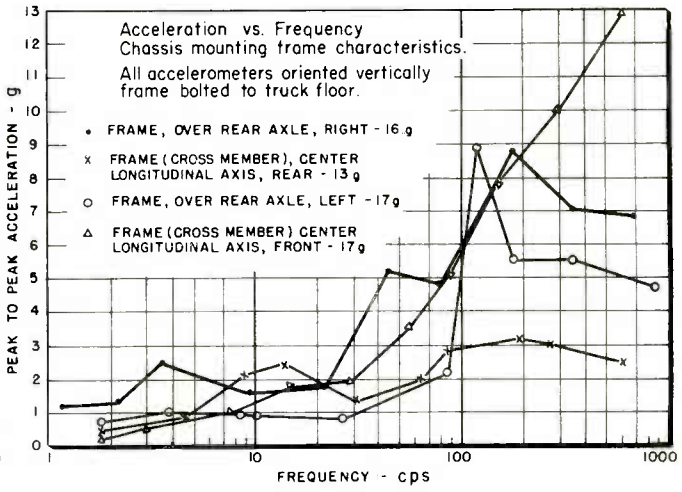


Fig. 8: (l) Acceleration spectrum of radio chassis during test. Fig. 9: (r) Acceleration spectrum of mounting frame during test

Vehicular Transportation (Continued)

the recorded signals can be performed by electrical means.

Fig. 5 gives a block diagram of the equipment which was used to make a frequency analysis. The output signal of the Ampex reproducer was connected to a Krohn-Hite bandpass filter which has an adjustable pass band. By playing back the same piece of tape repeatedly and changing the setting of the filter each time, one obtains on the ink recording galvanometer the signal amplitude for different frequency ranges as determined by the setting of the filter.

The transmission characteristic of the filter is given in Fig. 6 for a pass band one octave wide; this octave band was always used for making the frequency analysis. As can be seen from Fig. 6, the filter characteristic is not rectangular as could be expected from an ideal filter. Within the nominal pass band, the attenuation never exceeds 3 db; outside this band the attenuation increases gradually and finally reaches a slope of 23 db/octave. This characteristic makes it possible that very strong signals outside the pass band can show an appreciable output within the range of the filter.

Data and Results

Fig. 7 pictures the frequency analysis of a tie-down radio chassis in the left front cargo space, while the truck is traveling over an obstruction on the Circular Test Road. Note that the natural frequency of the fastened chassis is found to be 49 cps, and that higher frequencies of any significant magnitude are absent. The chassis has very little internal damping, and its natural frequency appears even outside the pass band of the filter because of the magnitude of accelerations involved. This is caused by the transmission characteristic of the band pass filter as explained before.

Figs. 8 to 12 present the acceleration spectra of radio chassis (fastened and loose), and of equipment on a moving vehicle and on the package tester. The overall "g" levels which were obtained without filtering are noted in the legend. The measurements were made with the ink recording oscillograph. All curves were obtained by evaluating the frequency analysis charts which look similar to that shown in Fig. 7. In Figs. 8 to 12, the peak to peak accelerations which can be read from the frequency analysis charts for each band of the filter were plotted versus the center frequency of this pass band.

Fig. 8 shows the acceleration spectrum encountered by various radio chassis in different locations of the truck, whereas Fig. 9 gives the accelerations which were measured on the mounting frame itself. Inspection of Fig. 8 and comparison with Fig. 9 reveals that the fastened chassis themselves act as mechanical filters. Because of their undamped natural resonant frequencies, they suppress the higher exciting frequencies and amplify the lower ones so that the frequencies of maximum acceleration—which appear in Fig. 9 always above 100 cps—are shifted downwards and are found below 70 cps in Fig. 8. The high-Q resonances which occur in the chassis—for example, the 49 cps peak shown in Fig. 7—cause a considerable amplification of the exciting acceleration. Care should be exercised, therefore, to avoid such amplification. This can

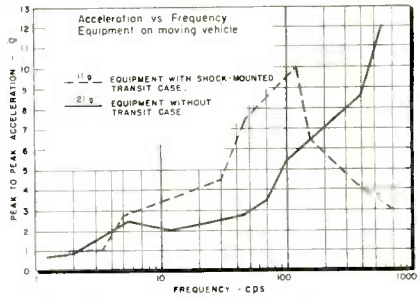


Fig. 10: Spectrum of equipment on moving vehicle with and without transit case

be done by dividing the chassis into compartments to lessen resonance effects or by providing damping for the resonances by using a soft metal for the chassis.

Acceleration Curve

The acceleration curve for the loose chassis (Fig. 8) is different from those of the fastened chassis. Since the loose chassis, which was unsymetrically loaded with 5 pounds, was free to bounce up and down, thereby hitting the metal frame, high shock forces are excited in that chassis which account for the high g values at frequencies above 100 cps.

Fig. 10 shows that the rail type shock mounts, together with the transit case in which they were used, provide protection against shock. The overall acceleration applied to the electronic equipment dropped from 21 g to 11 g. The frequency distribution, however, has changed. Above 150 cps, the acceleration decreases, but in the region from 4 cps to 150 cps the shocks are amplified. The reason for this behavior is the filter action of the shock mounts and of the transit case, which is similar to that discussed before for the electronic chassis.

The package tester has proven it-

(*Continued on page* 138)

How to Prepare

Printed Circuit Artwork

Practical techniques and precautions to insure accuracy. What every design engineer and draftsman should know

By JACK BAYHA, Director
Benton Laboratories
Twin Cities Airport
Benton Harbor, Mich.

THE first thing to bear in mind in the preparation of a piece of art work for a printed circuit is that the finished circuit can never be any better than your original drawing. Any errors, sloppy drafting, underinking, or other defects will appear with the same faithful reproduction as the parts of the circuit drawn.

There are a number of pitfalls to avoid, and placing these at the head of our list, we will attempt to make your next circuit a better one.

All work starts off with photography of your original art with a process camera. Dirty art work does not always reveal itself until it is placed before the all-seeing eye of this camera. The extreme resolving power of the lens used, coupled with the type of film employed, causes even the slightest speck of dust to photograph. When cameras are on the premises this causes no great delay—art can be cleaned up, and a new shot taken—but many companies do not have their own cameras, and extensive delays are caused by the need for rephotographing a particularly dirty piece of copy. Much can be cured by retouching, but it is best to cover art work with a clean sheet of tracing paper as soon as the drawing is completed. Simply fasten the paper to the back of the art with rubber cement, and fold it over the front. See Fig. 1.

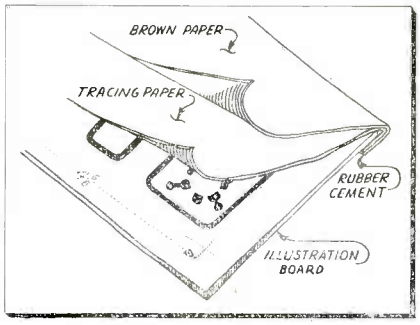


Fig. 1: Protecting original artwork

Dark Lines

All too often we find art sent to us for production purposes with lightly inked lines. These have a tendency to reproduce weakly, and poorly etched end products will result, unless these lines are retouched. This problem can best be controlled by using only a first quality ink, such as Higgins, for all inking work. Here it is important to note that small white openings left in inked areas cause pin holes in finished pieces, and they are difficult to retouch out from printing negatives. Be very careful when erasing that you do not "gray out" lines, or if you do, re-ink them to be sure you have a good, jet black, ink job.

Sharp Lines

Nothing can cause a worse looking circuit board than fuzzy lines in your art work. They can be avoided best by using a top quality, sharp ruling pen, for all outlining, and if you do not use grille systems (to be explained), use a top grade of artists illustration board of a type intended for use with ink. Here we can recommend Strathmore as being a high quality product. If you use tracing paper—tracing cloth is not recommended—be sure to use a grade intended for use with ink, and on completion securely mount the tracing paper to a sheet of cardboard by holding the corners with drafting tape. Do not cement it to the cardboard as almost all adhesives cause odd effects when the art is photographed. Leave the mounting to the printed circuit darkroom personnel.

Accuracy

The printed circuit engineer in the manufacturer's plant gets very irked at the engineers who prepare art work, labelling one dimension as is required and expecting some miracle of photography to alter another dimension other than to exact scale. While some forms of photography are capable of distortion, the camera used by the printed circuit darkroom crew (see Fig. 2) is made to be absolutely distortion-free. Any and all dimensions will be reduced by the exact same ratio. To assure a maximum accuracy always be sure to supply the one allowable dimension in the longest place possible. (See Fig. 3.) This will result in the greatest overall accuracy. Reduction size is generally measured with a scale on the ground glass of the camera, and errors of 0.010 in the measured size may be expected. Naturally 0.010 in 10 in. means a more accurate circuit than if the error were taken in only 2 in.

Do not dimension art by merely saying "4 x size" etc. Give one dimension to be held, and as accurately as you have drawn it, it will be reproduced.

All printed circuit production engineers know the shortcomings of

(*Continued on page* 143)

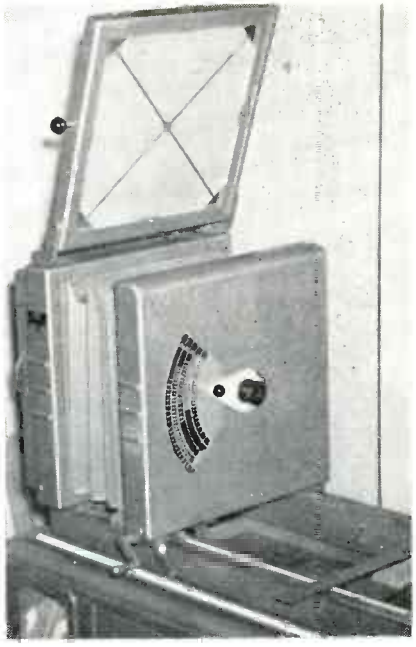
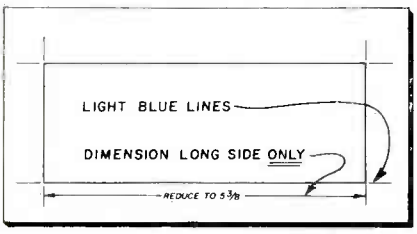
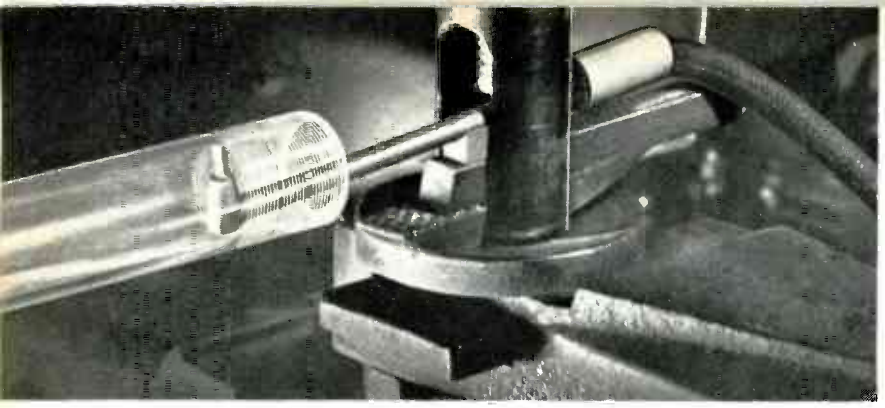


Fig. 2: Printed circuit distortionless camera

Fig. 3: Method of marking dimensions on art





(l) Cutting a 24-pitch thread on inside wall of glass tubing having ID of ½ in., using right angle nozzle with 0.006 x 0.06 in. rectangular orifice. Similar helixes have been cut in ceramic tubing with 0.17 ID. (r) Drilling depression in quartz disc. Hole is 0.03 in. dia., 0.015 in. deep.

By ROBERT R. GRETTER
S. S. White Industrial Div.
10 East 40 Street
New York 16, N.Y.

New Abrasive Process

High-speed gas-propelled abrasives cut hard materials on skin tissue. Applications include printed circuits,

THE principle of removing or cutting materials by means of abrasion or "sand blasting" has been known and used by manufacturers for many years. But it has been only recently, with the development of an improved process, called "Airbrasive" that the technique has been refined sufficiently to allow it to be used to perform relatively delicate operations on small electronic components.

Cutting Action

This improved process utilizes a high-speed gas-propelled stream of finely graded abrasive particles for its cutting effect. The stream, which is directed at the work through a small orifice nozzle, travels at a speed of about 1100 ft/sec. The kinetic energy thus produced, plus the expansion of the propellant gas, produces a cool and rapid cutting action.

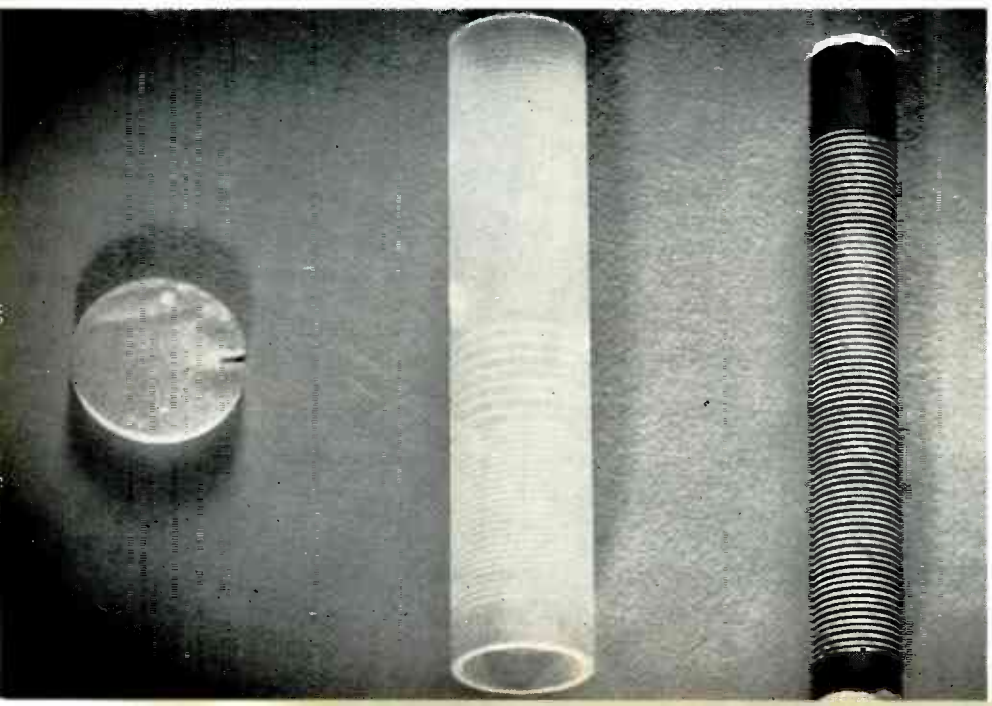
The size and shape of the nozzle orifice is determined by the job to be performed. Standard orifices include an 0.018-in. diameter round orifice and an 0.006-in. x 0.060-in. rectangular orifice. With the rectangular orifice, it is possible to cut lines as fine as 0.007-in. in hard, brittle materials.

Abrasive

Ordinarily, the abrasive material employed is aluminum oxide. However, for certain applications a lighter abrasive which is a mixture of magnesium and calcium carbonates has been found to be more suitable. A close particle size range of 27 microns is maintained. The abrasive material is contained in a special mixing chamber mounted on a vibrating unit. The action of the vibrator controls the richness of the abrasive mixture. By varying the impressed voltage across the vibrating unit, the flow of abrasive into the gas stream can be accurately proportioned to provide the correct cutting speed for the particular job being performed.

Further control of the cutting speed can be accomplished by regulating the distance of the nozzle tip from the work and by changing the gas pressure. Ordinarily, however, a fixed gas pressure of 75 psi is used behind the nozzle.

Typical applications of abrasive process are (l to r) quartz disc with pinpoint contact depressions, ground glass tubing with thread, and carbon film resistor with spiral groove

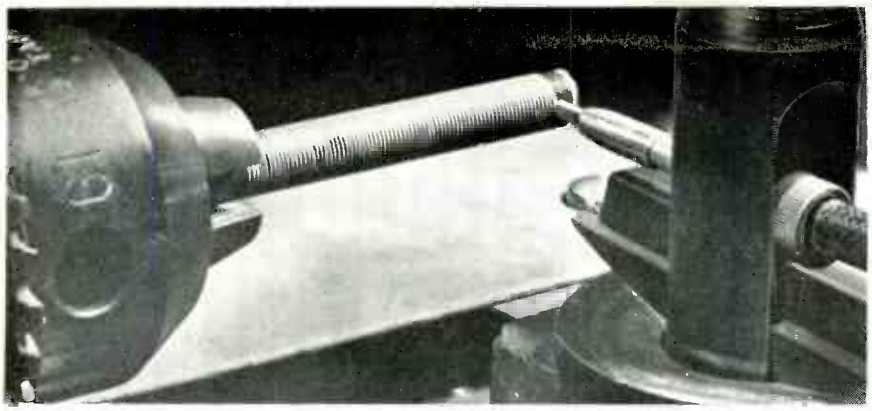


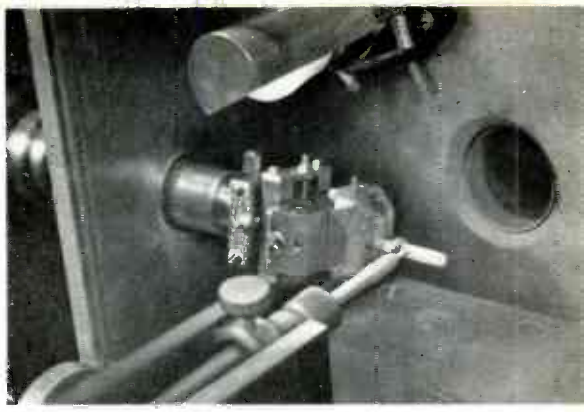
Advantages

One of the chief advantages of this process is its ability to remove material without the increase in temperature and without the vibration and pressure usually associated with other cutting methods. This is especially desirable when cutting thin crystals which have a marked tendency to shatter when subjected to undue shocks and pressure.

Another advantageous feature of the process is that each grain of abrasive contacts the work just once. In this way the full cutting effect of the abrasive material is realized, and the cutting is more uniform than might be expected with ordinary cutting tools which tend to lose their sharp edges with repeated use.

In addition, since the abrading can be accomplished without exerting pressure, surface irregularities in the work will not cause the "skips" and "jumps" that often occur when





(l) Cutting a continuous spiral groove in a deposited carbon film resistor, using a straight nozzle with 0.006 x 0.06 in. rectangular orifice. Cut width is 0.007 in. (r) Cutting and shaping cylindrical crystals used in neutron diffraction. Sizes are as small as fraction of mm dia., and 1.5 cm long

Speeds Component Production

and remove deposited surface coatings. Has no effect crystals, resistors, germanium and many others

a rotary contact tool is used.

The unique production possibilities of the "Airbrasive" process has led to its expanding use by electronic engineers in the production of components and for handling many difficult cutting and abrading jobs.

Cutting Germanium

An early application for the process was in the cutting of thin sections of germanium, one of the rare earth minerals used in transistors. The process proved to be highly successful for this purpose because it eliminated the possibility of shattering or chipping the material.

Printed Circuits

Most printing systems for resistor manufacture employed today are unable to mass produce resistive units to the close tolerances needed for electronic circuitry. To raise the resistance values to the desired degree, the "Airbrasive" process is now being employed as a means of removing the resistor material. In this type of application, the "Airbrasive" stream is directed at a part on the circuit at an acute angle. Control over the amount of resistor material removed can be obtained by limit bridges which automatically stop the flow of abrasive once the desired values are obtained. For resistors now lower than 60% below tolerance, the "trimming" can be accomplished in 8 seconds or less. (TELE-TECH, Sept. 1953, p. 78.)

The problem of cutting helical grooves in carbon film resistors is readily solved by the process. Generally, the resistor body, completely coated, is held in a lathe or similar device and rotated at a predetermined speed. The nozzle, mounted in a traveling tool holder, is set at a specified distance from the resistor. The film is then removed automatically. Uniform lines as fine as 0.007-in. can be obtained in this manner. With proper regulation, only the surface coating is removed without effect on the resistor body.

Shaping Fragile Crystals

Another interesting application involves the cutting and shaping of fragile crystals for neutron diffraction studies. Usually, these studies require cylindrical crystals several mm in diameter and about 1.5 cm in length. In the past, especially where crystals showed marked inequalities in rate of solution or hardness with crystallographic direction, the preparation of the crystals presented a difficult problem, since ordinary cutting or grinding operations would tend to fracture the crystals.

This process proved to be a handy solution to these difficulties. In actual application, the abrasive stream is first used manually to cut and shape the crystals in rough form. Then, the crystal section is mounted in a standard goniometer head and aligned optically or by X-ray. Once this has been done, the goniometer head is placed in a small lathe and slowly rotated in front of the abrasive stream. The process assures the production of cylinders of extremely fine and accurate circular cross-section.

In the production and design of electronic devices, the "Airbrasive" process has provided a method of doing many jobs that were either impractical or impossible to do by previously known methods. For the most part, the majority of applica-

(*Continued on page* 145)

Manual operation of electrically controlled "Airbrasive" unit using gas propellant

New Printed Circuit

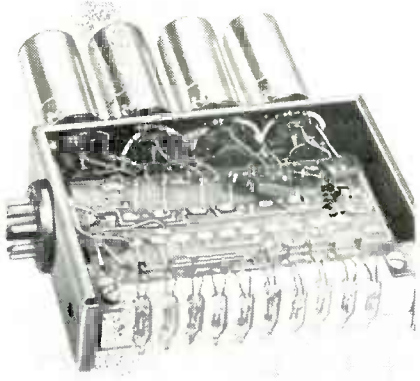
PULSE TRANSFORMERS

The new series, Type GEM, miniature plug-in pulse transformers for printed circuitry is available in the pulse width range from 0.05 to 2 μsecs—with two or three windings. The units are "Epoxy"

resin impregnated and molded. Operating temperature range is from –70°C. to 135°C. The transformers surpass MIL-T-27, Grade 1, Class A specifications. Size, ⅝ in. diam. by $\frac{9}{16}$ in. high. Weight, approximately 5 grams. Terminals are 22 AWG copper wire. Maximum length $\frac{1}{16}$ in. Hi-pot test, 2,000 v. RMS. **Gudeman Co. of California, Inc., 9200 Exposition Blvd., Los Angeles 34, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 12-17)

DECADE TOTALIZER

The TU-100P decade totalizer, designed for use where a large number of pulsations are counted and recorded, employs a new printed circuit to contribute greater operation stability. Greater heat dissipation results from better physical layout enabled by the circuit. The unit automatically records pulses separated by only 5 μsecs. No voltage regulation is required. Instant resetting is accomplished externally.



Has a direct-reading illuminated dial with constant frequency rate to 100 kc. Size 1¾ x 5½ x 5½ in. **Computer-Measurement Div., Detectron Corp., 5420 Vineland Ave., North Hollywood, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 12-3)

MORE TECHNICAL INFORMATION

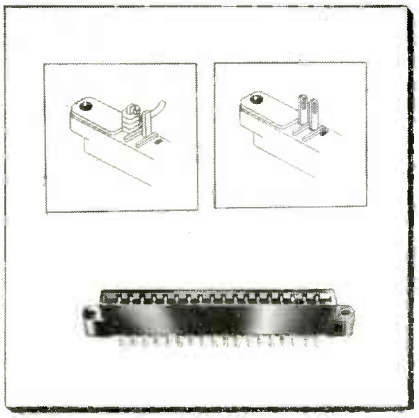
describing the new products presented here may be obtained by writing on company letterhead to New Products Editor, TELE-TECH & ELECTRONIC INDUSTRIES, 480 Lexington Ave., New York 17, N.Y., listing numbers given at end of each item of interest. Please mention title of position held.

ADHESIVE FOIL

P 195, a new adhesive coated copper foil for printed circuits has a heat resistance after cure to solder of 410°F. for 10 seconds, which betters NEMA standards. P 195 is a 1-oz. electrolytic copper foil coated with a thermosetting adhesive in dry film form that can be laminated to steel, brass, bronze, aluminum, wood, and phenolics. Sets at a glue line temperature of 325 to 350°F. for a period of 10 to 20 minutes. Pressure required for lamination is from 100 to 2,000 psi. **Permacel Tape Corp., U.S. Highway No. 1, New Brunswick, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 12-18)

PRINTED CONNECTORS

The "KKM" series connectors for plug-in printed circuit card applications are available in sizes ranging from 6 to 22 contact positions. Spring temper phosphor bronze contacts are offered in

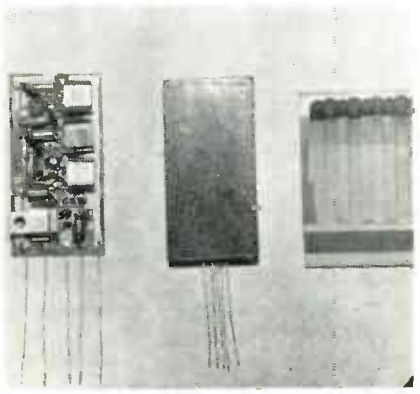


two terminal styles; (1) a slotted eyelet for soldering up to three No. 20 AWG cable wires per contact (2) a plain terminal to permit wire wrapping by the Western Electric Co. "Wire-Wrap" tool. Contact mv. drop is 10.5 dc at 3 amps rated current. Gold plating over silver provides low electrical resistance, corrosion prevention, and soldering ease. **Winchester Electronics, Inc., Willard Rd., Norwalk, Conn.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 12-19)

More New Products Appear On Pages 102 & 110

PRINTED AMPLIFIER

A new encapsulated, high-temperature resistance coupled, subminiature, silicon transistor servo-amplifier for airborne and guided missile applications, features printed wiring and re-



sistors. The printed unit is now available in sample quantities with solder terminals, or as a plug-in device. Size, $\frac{5}{16}$ x 1 x 2 in. Weight, less than ½ oz. Input impedance, 400 to 1,200 ohms; output impedance, 120 to 2,000 ohms. Power output, 73 mw. Sensitivity, 500 μv. Power source, 28 v. dc. **Plastics & Electronics Corp., 272 Northland Ave., Buffalo 8, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 12-23)

SILICONE

The dielectric capacities of silicones are made more useful packaged in an aerosal container and used as a spray. "SP-2," the new product, provides additional insulative protection to electronic equipment-particularly, equipment that is subjected to high altitudes, humidity, and marine atmospheres. The U. S. Signal Corps uses "SP-2" to prevent corrosion in exposed circuits. The

material also eliminates short circuits due to moisture leakage paths. Product is available in bulk-gals. and bbls. **Industrial Div. of Silatone Products Corp., Box 92, Dunellen, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 12-24)

Components & Equipment

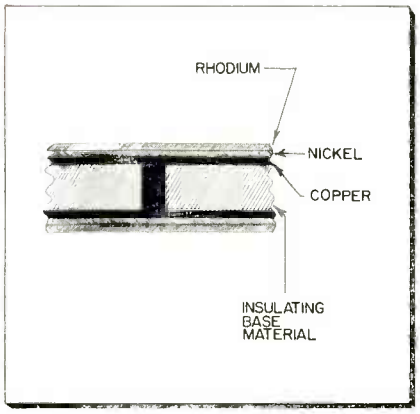
LABORATORY KIT

The S31 basic laboratory kit consists of six electrically conductive silver coatings, six resistance coatings, six accessory chemicals, manuals, data folders, etc. Quantities of materials range

from 1 oz. to 1 pint. It is said that the materials are most effective in solving research and design problems in various industries. Though conductive coatings usually are used in electrical or electronic components, they are used also in biochemistry, petroleum exploration, air conditioning, ceramics, acoustics, and the automotive and aircraft fields. **Micro-Circuits Co., New Buffalo, Mich.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 12-20)

PRINTED ASSEMBLIES

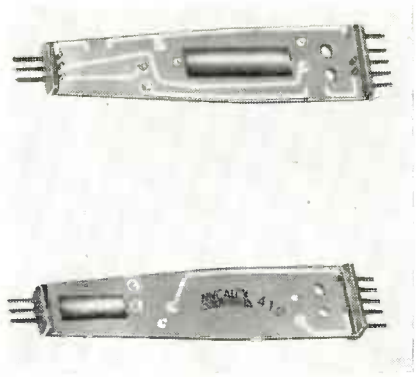
A new printed circuit process enables the maintenance of continuity from one side of insulating material to the opposite side (without visible holes or hardware) by electroplating copper for a sufficient time to close pre-punched holes. Various over-platings can be supplied, such as nickel-rhodium or electro-solder deposits, with a finished surface that enables commutator brushes or



switching contacts to ride over it without bounce. The method is used in assemblies ranging from radio sets to complex analog computers. **Insulated Circuits Inc., 115 Roosevelt Ave., Belleville, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 12-22)

MICA COMPONENTS

Printed circuit components, molded of glass-bonded mica with a continuous operating temperature limit of 650°F, are designed to tie in with the circuit and meet the user's precise specifica-



tions. The units feature molded-in inserts. The coefficient of thermal expansion of the components is close enough to that of most inserts to hold them tight over the operating ranges. The glass-bonded mica (Mycalex 410) from which the components are molded is structurally rigid and holds its hardware in true alignment. **Mycalex Corp. of America, 60 Clifton Blvd., Clifton, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 12-26)

TRANSMISSION DEVICE

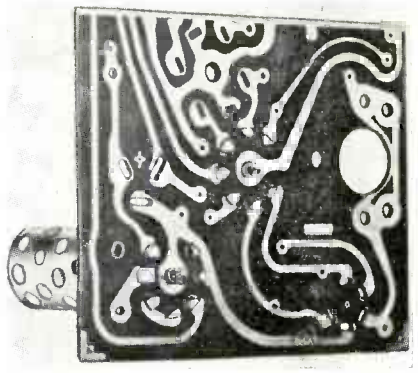
A new angular data transmission device, called the "Inductosyn", is a multipole synchro element which can serve as a shaft position data transmitter or receiver of great accuracy. Only 3 in. in diameter, the unit achieves an angular accuracy by electronic means equal to that of a precision mechanical dividing head or rotary table 3 to 6 times as large. The data elements are inductive in nature with the conductors being formed by photo-etched patterns on glass plates. **Farrand Optical Co., Bronx Blvd. & East 238th St., New York 70, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 12-25)

BINARY CODE DISCS

Four versions of the binary code disc for use in photoelectric, magnetic, or contact types of pickups are available with digital code wheel patterns on polished glass. Discs contain concentric zones of information in the gray code. Each zone has alternating opaque and clear angular sectors. Thin, opaque, annular rings separate adjacent zones. Total metal thickness is approximately 0.001 in. Opaque portion density to transmitted light is over 2.5. Transparent areas are bare, optically-polished glass without emulsion. **W. & L. E. Gurley, Industrial Div., Troy, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 12-21)

WAFER SOCKETS

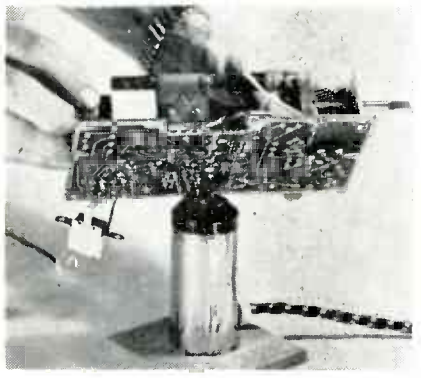
A recently designed laminated tube socket for printed circuit application utilizes twin wafers that support contacts with vertical terminals. The terminals snap into holes in the circuit panel,



which enables printing jumpers to connect different pin positions. Static load tests indicate that, when properly dip-soldered in a multiple hole pattern in a printed wiring panel, the socket will withstand a force of 10 times normal tube withdrawal force. Available in 7 or 9 pin types. **Methode Mfg. Corp., 2021 W. Churchill. Chicago, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 12-27)

HEATING POT

The production system of the "Placir" chassis eliminates the maze of wiring usually involved in the electronic chassis. In it, the individual wiring leads and wiring are produced as a single unit by a patented plating process applied to a phenolic base. A special controlled temperature heating pot has been developed as part of a five-step servicing plan for removing and replacing defective parts. Part removal is accomplished by heating all the terminals of the com-



ponent simultaneously. Following recommended procedure, enables removal of every chassis component without lifting the wiring pattern. **Motorola Inc., 4545 W. Augusta Blvd., Chicago 51, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 12-28)

Survey of New Products of the Month

Capsule summaries of latest electronic developments provide handy reference for engineers in the market for new equipment and components

Broadcast Equipment

TURNTABLE LINE. "Rondine Jr.", third of the 12-in. turntables produced by Rek-O-Kut Co., 38-01 Queens Blvd., Long Island City 1, N. Y., differs from two other line units in that it is designed for 33 1/3 and 45 rpm only. (Ask for A-12-1)

STUDIO SWITCHER for color TV broadcast service, announced by Engineering Products Div., Radio Corp. of America, Camden, N. J., is designed to handle camera switching, fading, and lap-dissolves in the studio control room; also signal inputs. (Ask for A-12-17)

DEVELOPING MACHINE. "Bridgematic" Model R-TV by S.O.S. Cinema Supply Co., 602 W. 52nd St., New York 19, N. Y., operates at about 100 degrees speeded up to 85 ft./min; 400 ft magazine takes loading spools right from camera. Film dries in few secs. (Ask for A-12-36)

16 mm. FILM STRIPER announced by Reeves Soundcraft Corp., 10 E. 52nd St., New York, N. Y., is identical in every important feature with the 35 mm. "Magna-Striper." Applies magnetic oxide in any of three widths—50, 100, 25 mil.—to 16 mm. film. (Ask for A-12-27)

OUTPUT AMPLIFIER by Peer Inc., 1200 Milton St., Benton Harbor, Mich., when used as a microphone amplifier to feed a radio transmitter, it is claimed, provides an average of 95% modulation utilization without over-modulation. (Ask for A-12-12)

Coils & Condensers

FLYBACK TRANSFORMERS. Three new flyback transformers designed for Admiral receivers, and two units for Emerson receivers have been added to the TV replacement line of Triad Transformer Corporation, 4055 Redwood Ave., Venice, Calif. (Ask for A-12-22)

CAPACITOR. The "Glassmike" TSG capacitor is for use in aircraft radio and radar equipment. Produced in 29 ratings and sizes. Smallest is a 0.0004 uf unit with 6,000 effective working volts rated 2 amps at 1 MC. Condenser Products Co., Div of New Haven Clock & Watch Co., 140 Hamilton St., New Haven, Conn. (Write for No. A-12-37)

TOROIDS. Dietz Design and Manufacturing Co. Grandview, Mo., has announced a new line of encapsulated toroids with guaranteed accuracies as great as 0.10% or 1 turn of winding where required. Hermetic sealing meets MIL-T-27. (Ask for A-12-29)

Electronic Components

LIGHTNING ARRESTER, is designed for maximum transmission of r-f energy in the 2-24 MC band. Will divert up to six lightning impulses. Made by Airtron, Inc., 1103 W. Elizabeth Ave., Linden, N. J., to protect aircraft communication gear. (Ask for A-12-6)

JACK AND PLUG. A sub-miniature closed circuit combination offered by Dept. KP, Telex, Inc., 1633 Eustis Ave., St. Paul, Minn. Phone type, approximately 1/3 the size of previous models; ¾ in. length. 9/64 in. diam. (Ask for A-12-23)

TRANSISTOR. A "super power" transistor that can deliver up to five amps of current to a motor has been added to the high-output transistor line made by Minneapolis-Honeywell Regulator Co., 2753 4th Ave., S. Minneapolis 8, Minn. (Ask for A-12-24)

VARIABLE DELAY LINE, available at Anderson Laboratories, Inc., 39 Talcott Rd. W. Hartford, Conn., effects continuous variation of delay time by rotary motion of a shaft. Variation can be as wide as 4 to 1 (10 to 40 μsecs). (Ask for A-12-18)

TUBE HOLDERS. Vertical subminiature tube holders of irridite-dipped cadmium plated spring steel made by Atlas E-E Corp., Bedford Airport, Bedford, Mass., hold up to 5 G's vibration at 500 cps. For 0.375 and 0.500 diam. (Ask for A-12-3)

ROTARY SWITCHES. The new "12000 Series" oval ceramic switches by Shallcross Manufacturing Co., 10 Jackson Ave., Collingdale, Pa. are available in shorting types with 20° or 30° indexing or non-shorting types with 40 or 60 indexing. (Write for No. A-12-19)

AC CIRCUIT CONTROL RELAY, designated Part No. 9100, made by Leach Relay Co., Div. of Leach Corp., 5915 Avalon Blvd., Los Angeles 3, Calif. has insulation, spacing, and contact life that exceeds UL requirements. 3 x 3⅛ x 2¼ in. in size. Weighs 14 ozs. Coils 6 to 230 v ac. (Ask for A-12-31)

Electronic Equipment

WIRE MARKING MACHINES by Kingsley Stamping Machine Co., 1606 Cahuenga Blvd., Hollywood 28, Calif., stamp the code or circuit number onto the wire insulation. Eliminate need for multiple inventories of color-coded wire, tags, etc. (Ask for A-12-2)

DECADE LOCALIZER, TU-100P, by Computer-Measurements Div., Detectron Corp., North Hollywood, Calif., employs printed circuitry to reduce cost and achieve greater resistance. Records pulses separated by only 5 μsec. (Ask for A-12-33)

MAGNETIC AMPLIFIER, Model MA65 announced by Sorensen & Co., Inc., 375 Fairfield Ave., Stamford, Conn. is tube'ess and designed for telephone and telegraph systems, radio, and TV. Input, 105-125 VAC, single phase, 60 cps. (Ask for A-12-5)

INDUCTION HEATER. Model 10,000 made by Radio Frequency Co., 44 Park St., Medfield, Mass., is fast enough to heat a ⅜ in. titanium rod to 3,400° F. in 9 secs. Soldering, welding, and annealing of common metals accomplished in fractional secs. (Ask for A-12-28)

NOISE FILTER, a new miniature molded radio unit designed by The Potter Co., 1950 N. Sheridan Rd., N. Chicago, Ill., to fit a small motor and gear assembly, reduces overall length of a conventional filter about 50%. (Ask for A-12-26)

PLAYERS AND RECORDERS. Magnetic tape players and recorders, by International Industries Corp., Dept. KP, 3101 E. 42nd St., Minneapolis 6, Minn., employ the "Isimetric" drive to operate tape handling without frictional clutches or brakes. (Ask for A-12-13)

TRANSMITTER-RECEIVER announced by General Electric Co., Electronics Park, Syracuse, N. Y., is a completely new 25 w. mobile combination that operates in the 152-174 MC band. Designed to work interchangeably from 6 or 12 v. battery. (Ask for A-12-10)

MACH NUMBER COMPUTER, CA-500, requires no vacuum tubes. Made by Servomechanisms, Inc., El Segundo, Div., 316 Washington St., El Segundo, Calif., the force-balance type unit provides accuracy of 0.01 Mach for 95% of laboratory test points. (Write for No. A-12-38)

MORE TECHNICAL INFORMATION describing the new products presented here may be obtained by writing on company letterhead to New Products Editor, TELE-TECH & ELECTRONIC INDUSTRIES, 480 Lexington Ave., New York 17, N.Y., listing numbers given at end of each item of interest. Please mention title of position held.

Materials

SILICONE RUBBER GUM, SE-30, announced by General Electric Company, Silicone Products Dept., Pittsfield, Mass., is a new, low-shrinkage gum being used in compounds for conventional molding, extrusion, calendering, coating, etc. (Ask for A-12-7)

PLASTIC IMPREGNANT, designated "Stycast 62" by Emerson & Cuming, Inc., 869 Washington St., Canton, Mass., is a low viscosity liquid for capacitors, filters, and r-f coils. Cured as a solid plastic its dielectric constant is 60 to 10^8 cps—2.6 (Ask for A-12-15)

COATING. "Rub-R-Ize," a liquid natural rubber applied like paint to insulate, waterproof, absorb sound, and prevent corrosion. Withstands temperature —20 to +220°. Rubber Magic Inc., 4312 3rd Ave., Brooklyn, N. Y. (Ask for A-12-32)

LAMINATED PLASTIC, "Gravoflex," announced by Hermes Plastics, Inc., 13-19 University Place, N. Y. can be bent by hand to any shape without breaking. Scratchproof and stainproof. Sheets, strips, 1/32, 1/16, ⅛ in. thick. (Ask for A-12-35)

Power Supplies

GENERATOR. Model 51SB, single sideband generator designed for operation with the Model 5100 transmitter by Barker & Williamson, Inc., 237 Fairfield Ave., Upper Darby, Pa., is self contained. Needs only a microphone. (Ask for A-12-30)

POWER SUPPLY, Model No. 200D-2, output voltage is varied from 100 to 2,000 v in 10-volt calibrated steps. Potentiometer varied between steps. Output current, 20 ma. Kalbfell Laboratories, Inc., P. O. Box 1578, 1090 Morena Blvd. San Diego 10, Calif. (Write for No. A-12-20)

SELENIUM RECTIFIERS. Two cartridge type selenium rectifiers, Types U45HP and U50HPF, have been developed by International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif., for use as high voltage power supplies—2 and 1⅞ in. long. (Ask for A-12-4)

POWER SUPPLY, No. MR2430-100X, announced by Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif., is a 28 v. 100 amp regulated magnetic amplifier. The tubeless unit is 25 x 15 x 15 in. in size. DC output, 24-30 v at 100 amps. (Ask for A-12-8)

RECTIFIER TUBE, NL-633, rated at 30 amp. dc and 225 amp. peak, is a new bracket mounting mercury-vapor rectifier made by National Electronics Inc., Geneva, Ill. that is adaptable to industrial applications. (Ask for A-12-9)

Resistive Devices

POTENTIOMETER, precision Series 42-900, is stocked for immediate delivery by Clarostat Mfg. Co., Dover, N. H. Design based on that of Series 42. Resistance range from 50 to 100,000 ohms in 10 standard increments. (Ask for A-12-25)

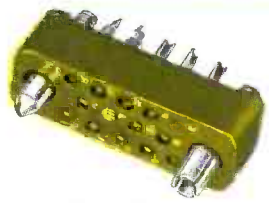
DECADE RESISTANCE UNIT, "Geda," is a plug-in device for analog-computing equipment, and special work in electrical laboratories. Four types have max. resistances of 1 and 10 megohm and 1 and 10 kilohms. Length 4 in.; diam. 1½ in. Dept. KP, Telex, Inc., E-A Div., Telex Park, St. Paul, Minn. (Write for No. A-12-39)

CONTROL, Model 2 "Snap-Tite" eliminates all mounting hardware, tab twisting, and mounting tools. Pushed into the mounting hole, the control simply snaps into place. Panels are gripped by six spring clips. Centralab, Div., Globe-Union Inc., 900 E. Keefe Av., Dept. F38, Milwaukee 1, Wis. (Write for No. A-12-40)

Centrally located plants at Chicago, Shelbyville, Indiana and St. Louis

CINCH PRODUCES

LOW LOSS MICA COMPONENTS IN QUANTITY.. ...QUICKLY



Miniaturized Micro Connectors that save space, weigh less and are more efficient . . . 14, 21, 34 and 50 contacts available in low loss material for chassis mounting applications.

Cinch components available at leading electronic jobbers —*everywhere*

Adequate and unequaled facilities have advanced CINCH to the foremost producer of low loss Mica components in production quantity.

CONSULT CINCH!

CINCH MANUFACTURING CORPORATION

1026 South Homan Ave., Chicago 24, Illinois

Subsidiary of United-Carr Fastener Corporation, Cambridge, Mass

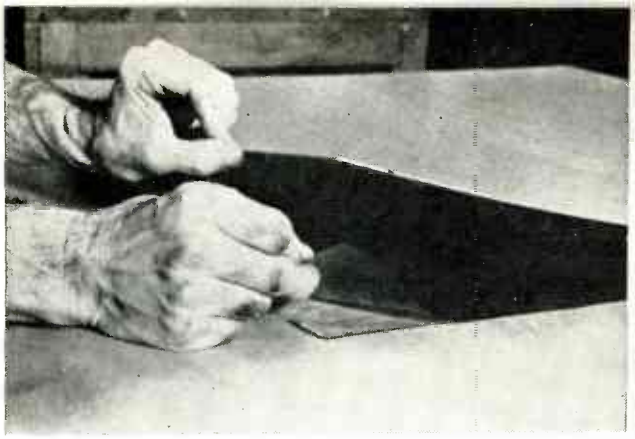


Fig. 1: Makeup sheet of foil-clad material consists of arranging laminate, adhesive (dry film in this instance) and copper foil in proper sequence. Adhesive must contact rough side of both laminate and foil for best possible bond. Fig. 2 (Right) Makeup for each sheet is sandwiched between clean smooth steel press plates. These assemblies are then stacked 5 ft. high (packs) for insertion in hydraulic presses

On Copper-Clad Laminates

SYNTHANE Corp., Oaks, Pa. reports:

In spite of the many different methods used to produce a functional printed circuit, each assembly is developed on the same basic engineering principle; the use of a current-carrying medium bonded to an insulating base. The electrical properties of the finished product are largely determined by the choice of base insulation, the selection of a metal conductor and the type of adhesive used to bond the two.

The most satisfactory printed circuit dielectric or insulating materials developed thus far are thermosetting laminated plastics. Tests have shown that any of the twenty-odd standard NEMA grades will produce a satisfactory bond with copper, however, NEMA grade XXXP-IR is usually recommended. This grade utilizes a paper filler and is produced, by impregnating or coating the filler material with a thermosetting resin and consolidating a predetermined number of layers using heat and high pressure. The ensuing chemical reaction transforms the layers into a hard, dense solid which will not delaminate and cannot be resoftened by additional applications of heat. Even in thin sheets, XXXP-IR combines excellent electrical properties with the good machinability so necessary for punching operations. In addition, this laminate is sufficiently hard to maintain a smooth surface after the metal foil has been bonded.

Laminates other than phenolics, such as melamine and silicone may also be used. Melamine resins are used where arc resistance is an important factor, and silicone resins are used when heat resistance is required.

In some special instances, Underwriters' Laboratory insists upon the base laminate having flame-retardant properties, and for this, there is a flame-retardant additive which has no important effect upon the electrical properties of any specified grade of laminate.

In practically all electronic applications surface resistivity, "Q" factor and moisture absorption are of prime importance. Dielectric and power factors impose additional requirements. An excellent example of this is television. The tuner, audio section, and the IF strip in a television set must have good surface resistivity and "Q" properties coupled with low moisture absorption, whereas the power supply requires

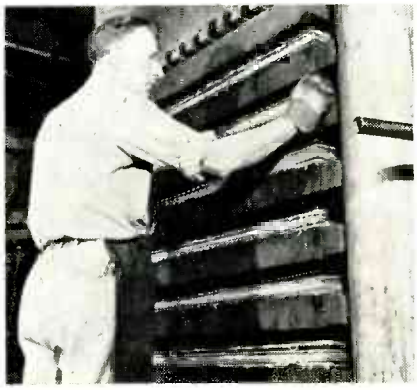


Fig. 3: Operator loads packs in 10 opening press. After one hour at 350° F and 1000 lbs/sq. in. foil and laminate are bonded

a good power factor and dielectric constant.

The various printing and etching processes also present a special set of difficulties. Numerous coatings, solvents, salt and acid baths, pumicing, and rapid temperature changes cannot help but have an effect upon surface resistivity since the base material will inevitably retain a small percentage of salts.

There is also the difficulty of obtaining a strong, uniform bond between the foil and the laminate. Good adhesion is needed to insure that the fragile pattern will adhere during fabrication and during the dip soldering of leads and components.

Aluminum Foil

Most methods of circuit printing use copper foils as the current-carrying medium, although aluminum foils are becoming increasingly popular for several important reasons. Aluminum foil is more plentiful, more economical and also possesses superior bonding qualities. In addition, it can be etched in a fraction of the time required for copper. The most serious disadvantage of aluminum to date has been the necessity for special surface preparation to permit soldering. This characteristic, however, can sometimes be used to advantage since the preparation may easily be stripped from sections where soldering is not required. This permits spot-soldering during a normal dip-soldering operation.

Production of the combination material which ultimately becomes a printed circuit begins with the purchase of foils in thicknesses ranging from 0.00135-in. to 0.0027-in. This roll material is cut into squares slightly larger than 36-in. x 36-in. sheet stock. Since cleanliness is of the utmost importance in securing a satisfactory bond between foil and laminate, foil must be thoroughly washed in an ammonia solution to remove applied coatings and foreign matter.

Choice of adhesive is particularly important. Of the many types of commercial compounds and films available, only a comparatively few are suitable for use with foil-clad

(*Continued on page* 112)

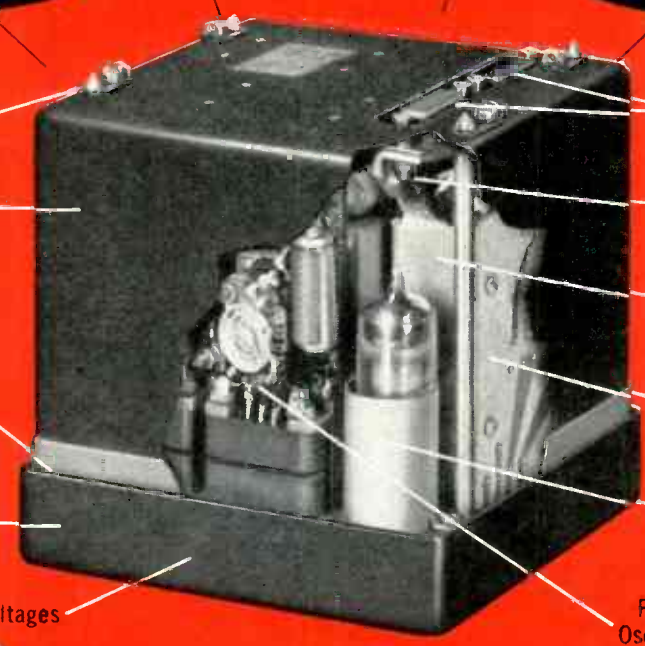
A NEW TELEMETER STANDARD

MORE RELIABLE

MORE VERSATILE

SMALLER

LESS INPUT POWER



BENDIX-PACIFIC TATP-4&5 PACKAGES

These compact Bendix-Pacific Telemetering Packages offer users of telemetering systems a **better** means to instrument such quantities as pressure, force, temperature, voltage, acceleration and vibration.

The units are smaller and various combinations may be used to provide compact multi-channel systems of up to 18 subcarrier bands. Each unit operates on **unregulated** +150 VDC and 28 VDC since it contains its own voltage regulating circuits. Each unit may be provided with individual relays for switching oscillator inputs from signal to calibrate position. Model TATP-4 contains four and Model TATP-5 contains six separate and independent regulated +5 VDC excitation voltage sources for use with resistance type pickups.

No vacuum tubes are required in mixing the outputs of the individual subcarrier oscillators to the composite audio signal for direct modulation of the RF transmitter, thus greatly improving the reliability of the system at a point where a tube failure would affect **all** subcarrier channels.

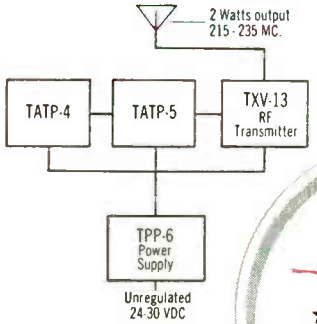
Standard Bendix Model TPP-6 Power Supplies are available to handle from one to three of these telemeter packages plus a 2 watt crystal controlled RF transmitter. Many types of interchangeable subcarrier oscillators are also available. RF amplifiers are available for increased power outputs up to 100 watts.

CHARACTERISTICS

	TATP-4	TATP-5
No. of bands	4	6
Subcarrier bands	1.7 kc. to 70 kc.	1.7 kc. to 70.0 kc.
Oscillator Types	TOE-30V, TOE-31V, TOR-8V, TOR-9V, TOL-9V	Same as TATP-4
Input Voltages	6, 12, or 24 VDC ±10% 150 VDC $\pm\frac{10}{5}$%	6, 12, or 24 VDC ±10% 150 VDC $\pm\frac{10}{5}$%
Weight (Less Oscillators)	Approx. 2 lbs.	Approx. 3 lbs.
Dimensions	5.0" x 5.0" x 4.5"	5.0" x 7.5" x 4.5"

Write for Complete Information

TYPICAL 10 BAND SYSTEM



PACIFIC DIVISION • Bendix Aviation Corporation

11610 Shermon Way, North Hollywood, California

RADAR

SONAR

HYDRAULICS

TELEMETERING

ELECTRO-MECHANICAL

ULTRASONICS

CUES for BROADCASTERS

(Continued from page 93)

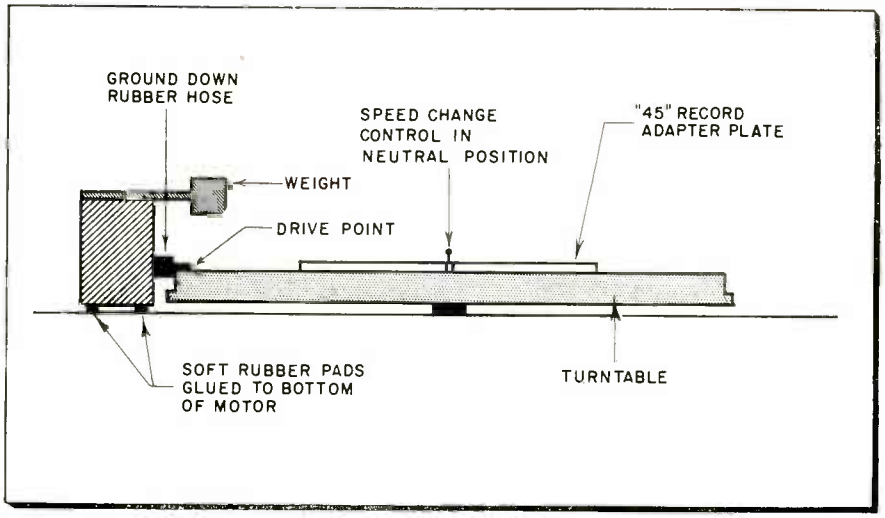


Diagram showing 45 rpm conversion details to Fairchild 254

is uncoupled from the drive.

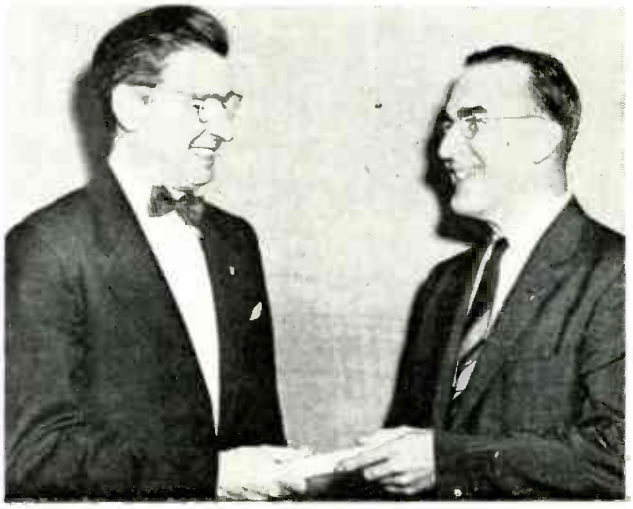
Now place another drive motor in such a position that it drives the turntable at 45 rpm. In our case we use a four pole motor of the type used on home recorder units. A piece of rubber hose is placed on the motor shaft so that it drives the turntable on the outer top of the turntable surface. The rubber hose is placed so that about ¾ in. of hose protrudes beyond the end of the shaft. The portion of the hose protruding beyond the shaft is then ground down to the proper size by holding a file against the rubber while the motor rotates.

The proper diameter of the rubber drive shaft is about ⅜ in. The speed can be tested as the grinding down progresses by means of the commonly available disc stroboscope. In operation, the motor should be placed so that only the ground down hose portion rests against the turntable, and all the ground portion must be on that part of the hose extending beyond the motor shaft. The weight of the turntable gives extremely good speed regulation, and there is no noticeable wow, rumble or hum pick-up from the extra motor. The total cost is well below twenty dollars.

The motor is shock mounted by the use of soft rubber pads glued to the bottom. The rubber mat must be removed from the top of the turntable for operation at 45 rpm because the rubber drive shaft rests on the top surface of the turntable. We have been using 45 rpm adapters to hold the record on the turntable and this makes the use of the rubber top mat unnecessary.

AES AWARD

Sumner Hall (l), Chairman of the Awards Committee for the Audio Engineering Society, presents the AES annual award to John D. Colvin, Director of Engineering for Gates Radio Co., Quincy, Ill. The citation was given for Colvin's efforts and accomplishments in the formation and progress of the society.

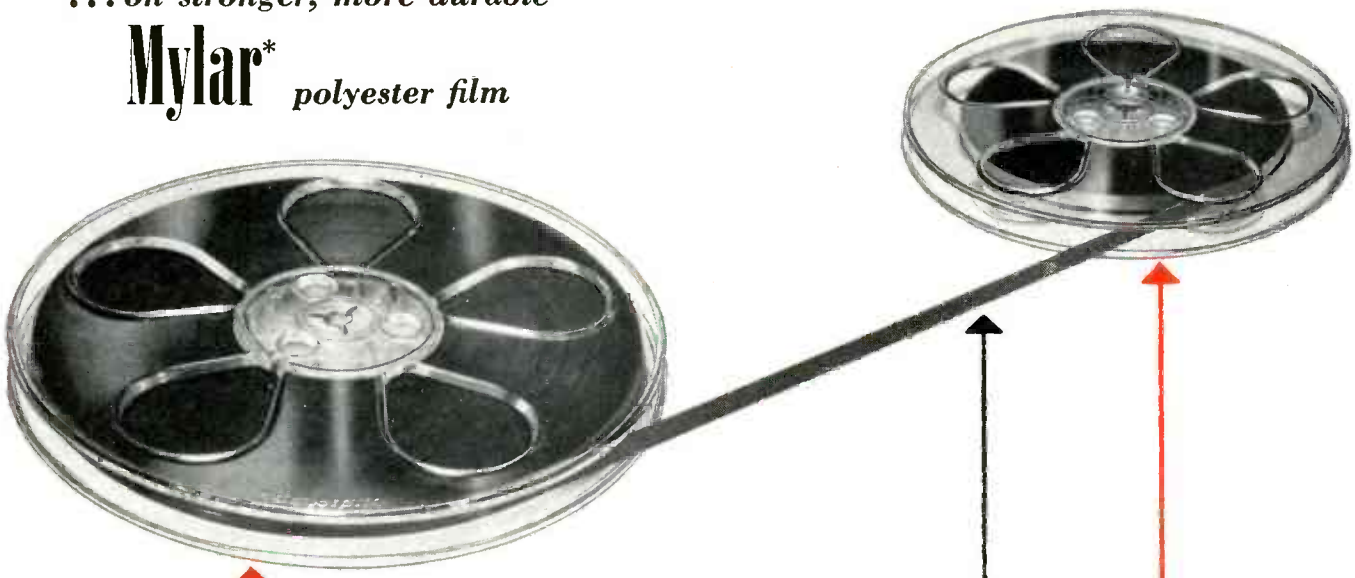


new type LR Longer Recording audiotape TRADE MARK

gives you 50% MORE recording time per reel

. . . on stronger, more durable

Mylar* *polyester film*



With Type LR Audiotape, you get the equivalent of a *reel-and-a-half* of ordinary tape . . .

900 ft on a 5″ reel
1800 ft on a 7″ reel
3600 ft on a 10½″ reel

Type LR Audiotape is made on a 1-mil base of stronger, more durable "Mylar" polyester film — withstands extreme temperatures, is virtually immune to moisture, gives maximum tape life under all conditions of use and storage.

This new *Longer-Recording Audiotape* saves time and effort, eliminates reel changes, gives uninterrupted continuity of recording and playback for *any application* where recording time exceeds the conventional reel capacity.

Laboratory tests, as well as unsolicited testimonials by radio stations and recording experts, have conclusively demonstrated the superiority of LR Audiotape — in both performance and durability. It is also important to note that the largest users of longer playing tape are now insisting that it be made on "Mylar" polyester film, the base material used for LR Audiotape — additional proof of its superior quality.

Ask your dealer for a supply of longer-lasting, longer-recording Type LR Audiotape. A copy of Bulletin No. 211, giving complete data and specifications on LR Audiotape, is yours for the asking.

*Du Pont Trade Mark

AUDIO DEVICES, Inc.

444 Madison Avenue, New York 22, N. Y.
Offices in Hollywood — Chicago
Export Dept., 13 East 40th St., New York 16, N. Y., Cables "ARLAB"

WASHINGTON
News Letter

Latest Radio and Communications News Developments Summarized by TELE-TECH's Washington Bureau

NO CHANGE—Barring some national emergency, the effect of divided control in Congress will probably have relatively small impact on President Eisenhower's administration policies in communications, broadcasting and electronics. This is especially true in this domestic field. Of course over wide areas of administrative responsibility Congressional action is not required and the administration will move along the same lines it has followed the past two years.

COMMITTEE CHAIRMEN—As a result of the final termination of the Senate race investigation of the television industry by the Senate Interstate Commerce Committee might be shelved with the succession of Senator Warren G. Magnuson (D., Wash.) to the committee's Chairmanship over Senator John Bricker (R., O.) who had sponsored the inquiry. The House Interstate Commerce Committee which handles communications-radio legislation in the next Congress is headed by Rep. J. Percy Priest (D., Tenn.) who is a middle-roader and a well-regarded veteran member of Congress.

McCONNAUGHEY VIEWS—Reaffirming his strong principles of favoring "as few controls as possible, and only those that are justified as basically necessary in the public interests," FCC Chairman George C. McConnaughey disclosed in an address before leaders of the radio broadcasting and television industry his broad principles on educational television and broadcasting regulation. He proposed to the educators that they should not let the 252 educational TV channels lie idle for too long a time and should plan this service on the basis of economics and practical usage. He gave credit to the commercial broadcasting and TV stations and networks for their contributions in educational broadcasts and video programs. While he is fundamentally opposed to FCC censorship of programs, the FCC Chairman cautioned broadcasters to be their own policemen through voluntary codes to guard against excessive "sales plugs."

WOMAN COMMISSIONER—The Eisenhower administration is considering the appointment of a southern woman Democrat to the FCC as a successor to Miss Frieda B. Hennock, New York Democrat, whose term expires next June 30. A possibility for the FCC appointment is reported to be Mrs. Ann Rutherford of Nashville, Tenn., Executive Secretary of the Tennessee State Funding Board, who had previously served for ten years on the staff of that state's regulatory commission.

MEXICAN BROADCASTING—Methods of establishing minimum interference operations, in broadcasting of American and Mexican stations, particularly in nighttime broadcasts, formed the subject of a conference between delegations, representing the two nations, staged last month in Mexico City. The United States delegation was headed by former FCC chairman Rosel H. Hyde and the conference was attended by frequency officials of the Radio Corp. of America, Westinghouse, and broadcasting networks. The blueprint formulated by the two nations is especially important for clear channel stations.

AVIATION COMMUNICATIONS—Through the joint efforts of the Air Navigation Development Board, Civil Aeronautics Administration and Radio Technical Commission for Aeronautics the half-way mark in the 15-year government-industry program for developing a "common system" of air traffic control has achieved a record of accomplishments reasonably abreast of schedule. New developments open the way for refinements or the need for still other equipment so no strict timetable can be observed and the sights of the program are now set beyond 1963. The focal point for the program is at the CAA new Technical Development and Evaluation Center at Indianapolis, with the Bell Telephone Laboratories in charge of the development work.

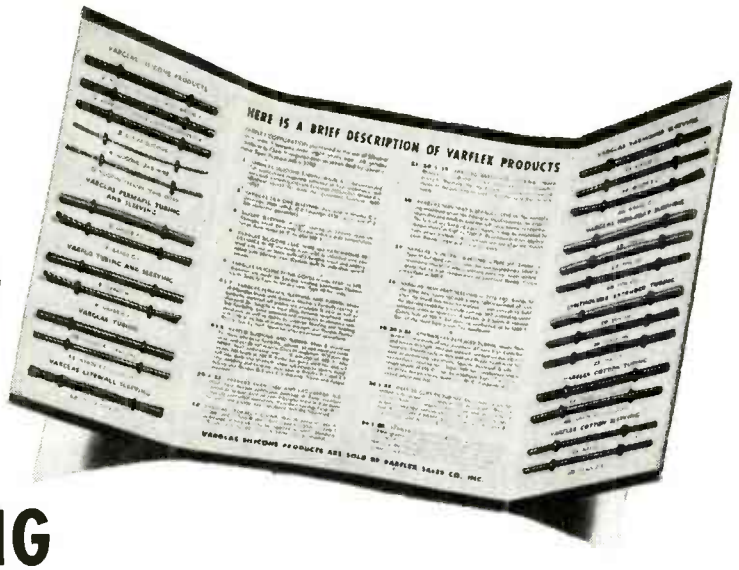
RADAR CONTROL—Use of radar in air traffic control is under extensive investigation at the Indianapolis evaluation center. ASR-2 S-band and L-band radar stations are used to provide surveillance of the lower altitudes, secondary radar equipment associated with these radar sets provide position information from aircraft equipped with ANDB radar safety beacons. During the next government fiscal year, starting July 1, extension of the enroute sector control will be expanded by the connection of the radar facilities in three Ohio cities with the Indianapolis center by microwave radio relay links. The major radio-electronics manufacturing companies are engaged in this ANDB radar program.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor

Send for this *Free* SAMPLE FOLDER...

Contains 25 different Test Samples of high-dielectric INSULATING TUBING and SLEEVING



INCLUDES SAMPLES AND DESCRIPTIONS OF THE FOLLOWING...

VARGLAS SILICONE Class H insulating materials were pioneered by our Laboratory. Retain flexibility, electrical properties and mechanical strength in temperatures ranging from —85°F. to 500°F. Available in tubing, sleeving, lead wire, tying cord.

PERMAFIL-IMPREGNATED VARGLAS TUBING Fiberglas braid coated with General Electric's Permafil resin. Extremely tough, resistant to solvents and elevated temperatures, highly flexible. Can be bent or twisted with little or no loss of dielectric strength. Coils and standard 36" lengths.

VARGLAS SLEEVING AND TUBING Numerous types and grades—including synthetic-treated, varnished, lacquered, saturated, litewall and others.

VARGLAS NON-FRAY SLEEVING Fiberglas braid normalized to remove all organic impurities. It will withstand temperatures up to 1200°F. Recommended where dielectric properties are not paramount. Three types available.

VARFLO TUBING AND SLEEVING Vinyl-coated Fiberglas in full range of sizes, colors and grades. Extremely flexible with excellent heat aging qualities. Low priced.

VARFLEX COTTON TUBING AND SLEEVING Varnish or lacquer impregnated — for applications where MIL-I-3190 Class A materials are specified. All NEMA grades.

SYNTHOLVAR EXTRUDED TUBING Made in various standard formulations of vinyl polymers. Has high dielectric and tensile strength—will not support combustion nor absorb moisture. Type EG Approved under MIL-I-631A. Several others to meet special requirements.

NEW! VARGLAS SILICONE RUBBER SLEEVING AND TUBING—the culmination of 5 years of research—for applications requiring extraordinary flexibility. Details on request.

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Please send me free folder containing samples of your electrical sleeving and tubing.

I am particularly interested in insulation for:

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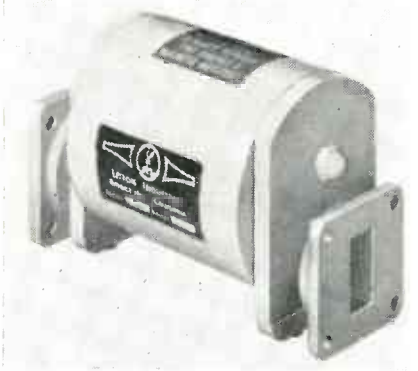
CITY..... ZONE..... STATE.....

New Electronic Products

LOAD ISOLATOR

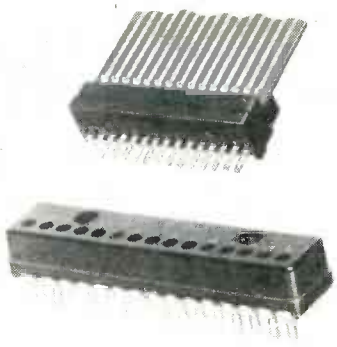
Model X20L unidirectionally attenuates load reflections without appreciably reducing the available generator power. The resonance absorption characteristics of ferrites used in the X20L enable



higher isolation over a wider band of frequencies than that available in previous units. A minimum isolation of 19 db and an average of 25 db is provided over an 8,600 to 9,600 MC band. Maximum input VSWR is 1.5 to 1, with output shorted, and power as high as 20 w can be applied. Other operating characteristics and frequency ranges available. **Litton Industries, Microwave Components Div., 336 N. Foothill Rd., Beverly Hills, or 215 S. Fulton Ave., Mt. Vernon, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 12-1)

MATING STRIP

Female mating strip No. 3372 is designed for permanent base mounting, and to be used with male connectors HHB Nos., 3367 and 3369. Fifteen pressure type sockets of beryllium copper are provided. Nominal creep of 3/32 in. Solder tabs are supplied for No. 20 wire. Plating is gold over silver. Standard insulating material is 3700 green, mineral-filled phenolic. Units are also available in mineral-filled phenolic type MFE,



diallyl phthalate MDG, or general purpose phenolic CFG. Printed circuit connector information available to design engineers and executives. **H. H. Buggie, Inc., 726 Stanton St., Toledo 4, O.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 12-2)

TAPE RECORDER

The professional Model DTM "Dynacord" tape recorder is driven by a new type hysteresis motor in which the flywheel is the rotor and the capstan that advances the tape is the rotor shaft. An

electric current stops the reels for the proper time at the desired moment. Dynamic braking is designed to maintain low tape tension without stretching. Unit has pushbutton controls for record, fast traverse, play, and stop. Interlocking prevents accidental erasure, tape spillage, or breakage. Has three motor construction, 1 capstan motor, 2 capacitor run torque motors. Accomodates up to 10½ in. reels inclusively. **Pentron Corp., 777 South Tripp Ave., Chicago 24, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 12-15)

MICROWAVE SYSTEM

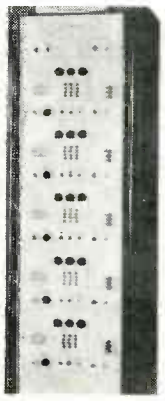
The TRC-12 "Telelink" is a new low-cost communications microwave system designed and engineered to provide reliable service for one and two channel operations in the telephone industry, pipeline companies, railroads, power companies, air lines, turnpike authorities, and state and city governments. It features low equipment cost, low installation cost, and low operational cost. No outside housing is required. Standardized, long-life parts are used throughout. All components are selected to operate well within their rated values. **Raytheon Manufacturing Co., Waltham 54, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 12-6)

MORE TECHNICAL INFORMATION

describing the new products presented here may be obtained by writing on company letterhead to New Products Editor, TELE-TECH & ELECTRONIC INDUSTRIES, 480 Lexington Ave., New York 17, N.Y., listing numbers given at end of each item of interest. Please mention title of position held.

INTERVAL GENERATOR

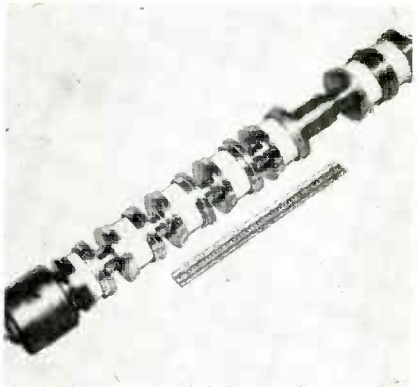
The Model 3157 multiple-sequence MC preset interval generator develops a series of preset time delays adjustable in increments of 1 μsec. A 1 MC crystal-controlled master oscillator feeds one



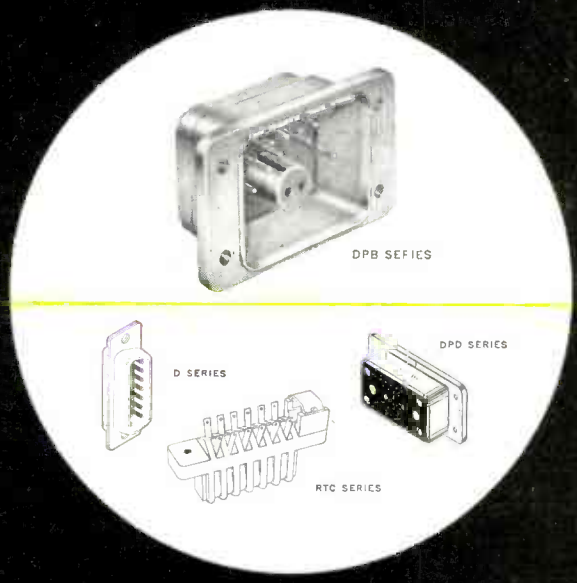
or more preset counters capable of producing an output pulse of any desired number of counts (μsecs) after application of a start pulse. Up to 999, each counter is set at the desired number of μsecs by means of front panel selector switch. Direct indication in μsecs is by neon lamps in binary-coded decimal form. **Potter Instrument Co., Inc., 115 Cutter Mill Rd., Great Neck, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 12-13)

KLYSTRON

The Model X566 for distance measuring equipment delivers over 20 kw of peak pulse power with only 100 mw drive—a power gain of 53 db in UHF operation at 900-1,400 MC. A feature is the "Eimac" modulating anode which greatly simplifies pulsing equipment. Ceramic and copper construction enables wide range tuning and easy adjustment of input and output coupling devices. Especially significant is the average power capability of 1 kw which would allow a 5% duty cycle with a 20 kw peak output; 10% with 10 kw,



etc. **Eitel-McCullough, Inc., 798 San Mateo Ave., San Bruno, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 12-8)



for rapid disconnect

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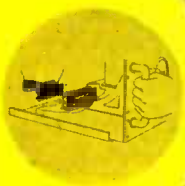
connectors

speed up inspection...testing...maintenance! facilitate interchangeability!

You can connect, disconnect, interchange, replace, test, and inspect instruments, assemblies, and sub-assemblies easily and rapidly when you use Cannon "Unit Plug-In" multi-contact electric connectors.

You'll find some with shells . . . some without. Shell style units . . . in a wide variety of designs . . . are ruggedly constructed to take the many "in" and "out" operations of rack, panel, chassis, and sub-assembly applications. Varied, simple, but always rigid mounting facilities provided on each connector half. Standard, miniature, sub-miniature sizes. Either connector half may be made into a plug by use of an end bell. Up to 156 contacts. And . . . an amazing number of combinations of contacts for control, audio, thermocouple, co-ax, twin-ax, as well as pneumatic connections. In single- or double-gang. Special moisture-proofed types. Standby units feature gold-plated contacts to withstand deterioration and corrosion. Write for full information. Write TODAY!



first in connectors

CANNON PLUGS

Please refer to Dept. 201

CANNON ELECTRIC COMPANY, 3209 Humboldt Street, Los Angeles 31, California. Factories in Los Angeles; East Haven; Toronto, Canada; London, England. Contact representatives and distributors in all principal cities.

BIASTRE

Copper Laminates

(*Continued from page* 104)

materials. Requirements are particularly rigid because the adhesives used in printed circuit materials must possess the following qualities:

1. Be sufficiently strong to withstand punching, milling and other fabricating procedures, along with innumerable handling and assembly abuses.
2. Be able to resist strong etching solutions.
3. Must possess sufficient heat resistance to withstand the baking of resists prior to etching and to permit soldering without blistering.
4. Must be resistant to moisture.
5. Must match the laminate in electrical properties.

The most satisfactory adhesives for bonding laminates are the thermosetting and thermoplastic types, usually in combination. Thermoplastic adhesives are made from rubber, rubber substitutes, cellulose ester, or thermoplastic resins of the vinyl type. These adhesives are characterized by their rather poor heat resistance and susceptability to blistering during soldering operations. They also tend to cold flow during normal operating conditions.

Thermosetting adhesives are made from urea-, melamine-, phenol-, or resorcinal-formaldehyde resins. While cold flow is not a problem, these do not possess the necessary degree of shock resistance. The most satisfactory adhesives are the mixtures of thermosetting and thermoplastic resins which retain the desirable qualities of each type.

Bonding Process

The actual mechanics of bonding foil to a laminate may be accomplished by one of two methods. Class 1 foil-clad laminate is produced from a predetermined number of resin-impregnated sheets to which a thin, dry sheet of adhesive film is added, followed by a sheet of metal foil approximately 0.0027-in. thick. The entire build-up is then subjected to heat (approximately 320°F.) and high pressure (approximately 1000 psi) for about one hour. The adhesive and foil may be added to both sides of the build-up.

Class 2 foil-clad laminate is designed to meet closer thickness tolerances than Class 1 material. It is produced by sanding a finished, cured sheet of laminate to the desired thickness, after which the ad-

(*Continued on page* 114)

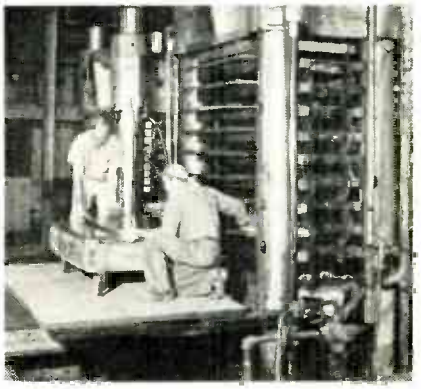
National Vulcanized Fibre Co., Wilmington, Delaware reports on copper-clad laminates:

Fig. 1: (below left) Chemical treatment of copper foil surface removes oil and grease and acts to improve bonding of copper to laminate base

Fig. 2: (r) Copper foil being laid on "build-up" of base laminate. Foil ranges 0.0028 to 0.0035 in. in thickness; weighs 1 or 2 oz./sq. ft.

Fig. 3: (below right) Copper clad sheets being removed from hydraulic press, where they have been bonded at 300° F, 2000 lbs./sq. in. for 30 min.

(*Continued on page* 116)



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This engineer just solved one in a matter of moments with his copy of **Catalog No. 200, Vac-Tite* Compression Multi-Headers:**

The Problem:
4-terminal headers for a cover on a sensitive relay enclosure.

The solution:

The exact part he needs is found on page 3. **Hermetic** part number MSC 375E-400 EA4 meets the need perfectly with four terminals, hooked outside, straight-cut inside; a flange reversed body, for inside mounting in a plain, pierced, .350 dia. hole.

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Now Available, Hermetic's Catalog No. 200, Offering Unparalleled Coverage of Vac-Tite* Compression Multi-Headers.

This handy desk-side reference on compression multi-headers is the latest volume of a series on hermetic seals for electronics "packaging". This series codifies and catalogs every significant innovation in hermetic seals. When complete, we believe you will find the **"Encyclopedia Hermetica"** the easiest, most helpful source of design and purchasing information on hermetic seals available in the industry.

Hermetic's Catalog No. 200, Vac-Tite* Compression Multi-Headers, lists over 2,500 separate variations in body constructions, sizes and terminations. This wide selection is codified and arranged in an easy tabular form so that selection is almost automatic. When using this catalog, almost any conceivable preferred type of multi-header can be located and identified by its exact **Hermetic** number in a matter of seconds.

You will find a copy of this latest volume of the **"Encyclopedia Hermetica"** a most useful desk-side aid in selecting the exact multi-header you need—why not write today for your free copy?

*Vac-Tite—a major improvement in mechanical strength and rigidity, achieved by **Hermetic's** exclusive glass-to-metal chemically bonded compression construction.

Hermetic Seal Products Co.

33 South Sixth Street, Newark 7, New Jersey

FIRST & FOREMOST IN MINIATURIZATION

Copper Laminates

(*Continued from page 112*)

hesive and foil are added. It then goes back to the press for a second application of heat and pressure. In all cases the adhesive layer eventually becomes an integral part of the laminate and must match the NEMA characteristics.

Bond strength varies with foil thickness. In general, the greatest adhesive strength is achieved with thicker foils. The bond strength of Synthane foil-clad laminates is about 5 lbs. minimum. Strength is tested by scoring the foil side of the laminate to produce a strip one inch wide. A portion of this strip is peeled from the laminate and a clamp is affixed to the end. The clamp supports a container into which sand or lead shot is poured. The weight of the container when it causes the test strip to peel is considered the bond strength.

Heat Tests

Because it is necessary that foil-clad laminates withstand soldering, heat resistance tests have become standard. A specimen may be tested in a dry circulating air oven (275° F.) for 30 minutes or floated in a pot of molten solder, foil side down. The resulting foil-clad materials may be sawed, milled or drilled. Standard punching grades are also available. Parts are usually fabricated after printing and etching.

More than a hundred companies offer some type of commercial design and fabrication service for "printed" circuitry. Many of these companies, (and their numbers are increasing daily) process foil-clad laminates exclusively. Although there are many variations, most processing methods utilize some form of photo-etching to produce a circuit. Methods based upon silk screening processes, run a close second in popularity.

Conclusion

A rough idea of the future of thermosetting laminates in printed circuitry can be obtained from the fact that the average production run of television sets is between two and three thousand per day. Each of these TV sets will eventually use about one pound of foil-clad laminates. Major producers of radio sets assemble an average of one million sets per year, each of which will incorporate printed circuitry. Manufacturers of computers and various types of electronic office equipment see printed circuits as the answer to space problems.

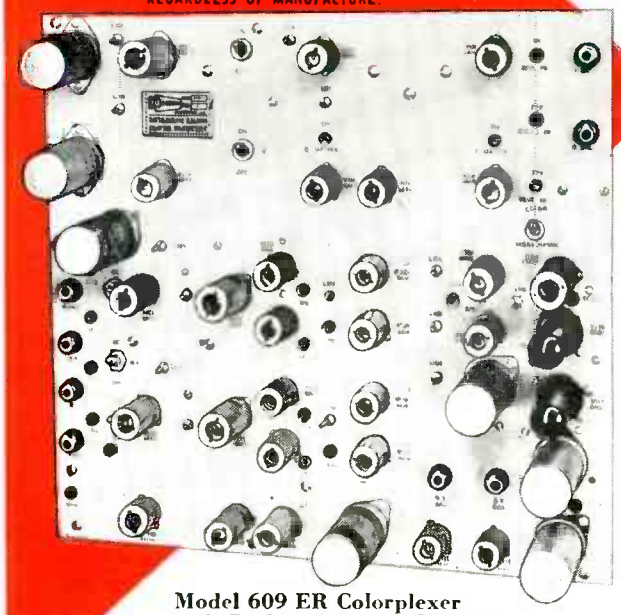
SOLVED! COLOR TV DRIFT PROBLEMS IN COLORPLEXING EQUIPMENT

TELECHROME SHOWS THE WAY

TELECHROME INCORPORATED

AUTOMATIC BALANCE CONTROL

Model 617 BR
Automatic Balance Control
for ALL COLORPLEXERS
REGARDLESS OF MANUFACTURE



Model 609 ER Colorplexer with Built-in Balance Control

ALL COLORPLEXERS DRIFT

One of the most difficult problems with which the color TV broadcaster is faced is that of drift in the modulator sections of the colorplexer. ALL COLORPLEXERS DRIFT, some more than others, but—

On the average, colorplexers require at least two hours of warm-up time and must be re-balanced a few times during a normal day's operation. Unbalance causes color receivers to "see" the wrong colors. TELECHROME'S new Model 617-BR Automatic Balance Control completely eliminates drift problems and works with ALL TYPES OF COLORPLEXERS REGARDLESS OF MANUFACTURE.

ELIMINATES DRIFT PROBLEMS

An ingenious circuit locks the entire color encoding equipment in balance within 20 seconds after being turned on. Thereafter balance is held, even after weeks of operation.

The Automatic Balance Control holds balance even under conditions where ordinary colorplexers would go completely out of control—tubes may be replaced, room temperature conditions may be varied, line voltages may be changed, manual controls may be turned, tube types may be substituted—NONE of these conditions affects the colorplexer kept under control by the TELECHROME Model 617-BR Automatic Balance Control! WARM-UP TIME IS UNNECESSARY; this alone saves many engineering hours per week. And need for stand-by personnel to reset balance is eliminated.

A memory system is incorporated so that interruptions in signals or switching transients will not interfere with the operation of the correction circuits.

NEW AUTOMATIC BALANCE CONTROL COLORPLEXER

The Model 609-ER Colorplexer is the ONLY unit engineered to incorporate Automatic Balance Control in order to eliminate chroma unbalance components in a color signal and to keep the colorplexer in balance at all times. This new Colorplexer design completely eliminates the necessity for manual adjustment of balance controls.

DELIVERY 30 DAYS

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Color Bar
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Chromascope
Vector
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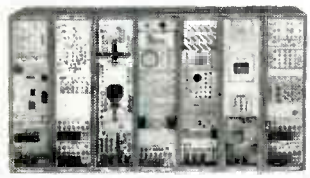
Phase Slope
(Envelope Delay)
Curve Tracer



Full facilities
Transmits,
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composite
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AMityville 4-4446

Copper Laminates

(*Continued from page* 112)

Fig. 4: Testing bond tightness. Done on a 1 x 4 in. strip with a 1 in. peel

Fig. 5: Dip solder tests. One sq. in. blocks of copper clad phenolite are checked for blistering and adhesion. Usual NEMA test is 220° C for 10 seconds

On Automatic Chassis Production

Last September the editors of TELE-TECH AND ELECTRONIC INDUSTRIES presented the first pictures of a new machine for the automatic production of electronic chassis developed at the United Shoe Machinery Corp. in Boston, Mass. More detailed photos below review the operation of this equipment which, incidentally, is now undergoing trial runs at an undisclosed manufacturing plant. (rumored to be RCA)

(*Continued on page* 130)

Overall view of first machine in plant

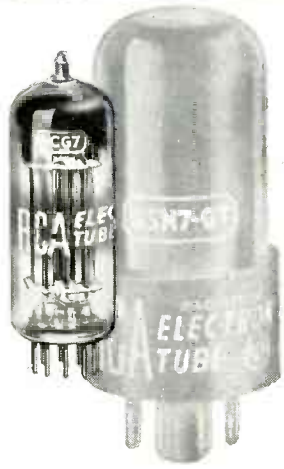
RCA

TECHNICAL NEWS FOR DESIGNERS

FROM THE RCA TUBE DIVISION

NEW! RCA-6CG7
Miniature Version of 6SN7-GT

The new 9-pin 6CG7 is an RCA development. It's a general-purpose, medium-mu twin triode intended particularly for use as a vertical and horizontal deflection oscillator in TV receivers. Because of its compactness, the RCA-6CG7 is ideal for use in printed circuit sockets. It employs a structure which permits cool operation of the grids to minimize grid emission, and an internal shield to prevent coupling between the triode units. Designed with a 600-ma heater having a controlled warm-up time, the tube assures dependable performance in series-string TV circuits. The RCA-6CG7 can also be used as phase inverter, multivibrator, sync-separator and amplifier, and resistance-coupled amplifier.



RCA "SPECIAL REDS" for special industrial applications

The 10,000-Hour Plus Line

RCA "Special Reds" are receiving-type tubes designed specifically for unusually exacting requirements. These tubes offer extremely long life plus the special characteristics needed wherever uninterrupted operation of equipment is required. These tubes are engineered to minimize the effects of shock, vibration, and the continuous operation found in industrial service. Their high quality is "built in" rather than "tested in." So insist on RCA "Special Reds," the finest receiving-type tubes your money can buy for rigorous, industrial applications!

RCA BATTERIES—Types for virtually every need!

More than 80 different types... ranging from the tiny penlite batteries to large types for industrial application... make up the RCA line. Special types are available for circuit designers and experimenters—such as the small, versatile "slice-away" batteries (VS087 and VS068) for use with subminiature tubes and transistors. RCA application engineers will gladly discuss your design problems with you. Write for battery catalog (BAT134B).

TWIN BEAM POWER TUBE
for 450-470 Mc Operation

RCA-6524

is well-suited for fixed and mobile UHF design—as a balanced push-pull rf power amplifier or frequency tripler. Delivers 20 watts (approx.) under ICAS conditions in class C cw and fm services—at 462 Mc! Maximum plate dissipation is 25 watts (ICAS). Cathode inductance is reduced to a negligible value by a common cathode for the two units.

For technical data on any of the products shown, write to RCA Commercial Engineering Section, L50R, Harrison, New Jersey

ELECTRON TUBES • SEMICONDUCTOR DEVICES • BATTERIES • TEST EQUIPMENT • ELECTRONIC COMPONENTS

RADIO CORPORATION of AMERICA

TUBE DIVISION HARRISON, N. J.

Military Contract Awards

Electronic products, dollar value, and names of manufacturing contractors receiving awards as reported by U.S. Dept. of Commerce.

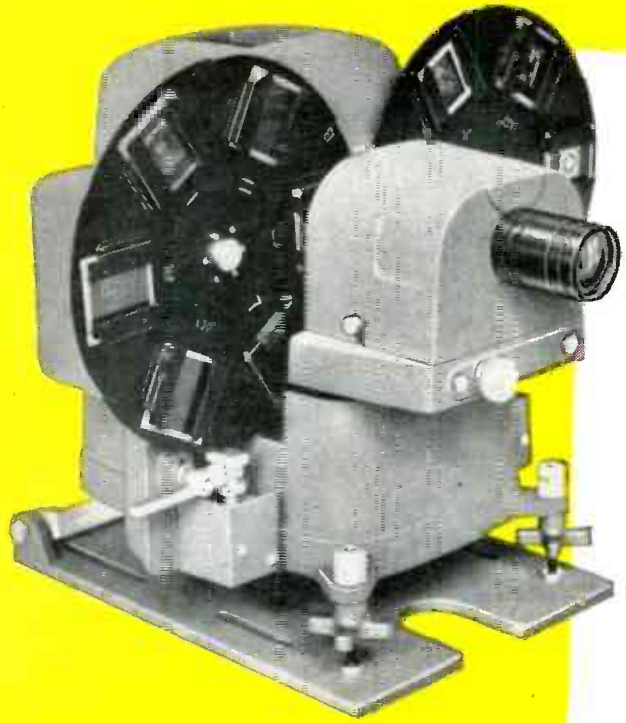
Battery—33,510—Ray-O-Vac Co., 212 E. Washington Ave., Madison, Wis.
Electron Tube—94,675—Eitel McCullough, 798 San Mateo, San Bruno, Calif.
Electron Tube—35,133—Eitel McCullough, 798 San Mateo Ave., San Bruno, Calif.
Electron Tube—85,245—Raytheon Mfg., Newton, Mass.
Electron Tube—42,160—Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N.Y.
Indicator, fuel—59,851—Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Generator Set, electric—82,342—Gremce Inc., Ft. Worth, Texas
Generator, control panel—124,809—General Electric Co., Schenectady, N. Y.
Radar Set—996,124—Sperry Gyro Co., Div. Sperry Corp., Great Neck, L. I., N. Y.
Overhaul and Repair, radar sets—1,070,000—Motorola, Inc., Chicago, Ill.
Generator, tachometer—27,131—General Electric Co., 1405 Locust St., Philadelphia, Pa.
Actuators—65,836—Air Associates, Teterboro, N. J.
Earphone Cushion—49,265—Permaflux Corp., 4900 W. Grand Ave., Chicago 39, Ill.
Battery, storage—45,097—Price Battery Corp., Grand St., Hamburg, Pa.
Cable, watertight—261,429—Anaconda Wire & Cable, P. O. Box 128, Hastings-on-Hudson, N. Y.
Cable, watertight—28,800—Rockbestos Products Corp., Nicoll and Canner Sts., New Haven 4, Conn.
Cable, watertight—230,200—General Electric Co., Construction Material Div., Wire & Cable Dept. 1285, Boston Ave., Bridgeport 2, Conn.
Cable, watertight—61,781—Phelps Dodge Copper Products Corp., Habirshaw Cable & Wire Div., 40 Wall St., New York 5, N. Y.
Cable, watertight—35,928—General Cable Corp., 123 S. Broad St., Philadelphia, Pa.
Cable, telephone—28,536—Plastoid Corp., Hamburg, N. J.
Cable, watertight—37,318—Collyer Insulated Wire Company, 249 Roosevelt Ave., Pawtucket, R. I.
Acoustic Cable Reel—122,516—Combined Industries, Catskill, N. Y.
Elements, storage battery—2,966,764—Gould National Batteries, Inc., Depew, N. Y.
Chassis, amplifier—652,131—Bill Jack Scientific Instrument Co., Solana Beach, Calif.
Amplifier, type D-1—147,034—Allen B. Dumont Lab. Inc., Clifton, N. J.
Receiver, transmitter selector control—2,424,660—Webster-Chicago Corp., Chicago, Ill.
Dynamotor—86,698—Red Bank Div., Bendix Aviation Corp., Eaton, N. J.
Spare Parts, radar trainer—450,000—Gilfillan Bros., Inc., Los Angeles, Calif.
Components, radio set—120,618—Stewart-Warner Corp., Stewart-Warner Elec. Div., Chicago, Ill.
Computer, control—109,541—Western Electric Co., Inc., New York, N. Y.
Radio Set—1,391,457—Sylvania Electric Products, Inc., Radio and Television Div., Buffalo, N. Y.
Gyroscope, miniature—31,672—Kearfott Co., Inc., 1378 Main Ave., Clifton, N. J.
Radar Set—12,228,554—Western Electric Co., New York, N. Y.
Generators, signal—251,693—Hewlett-Packard Co., Palo Alto, Calif.
Rheostats—18,072—Ohmite Manufacturing Co., 3601 W. Howard St., Skokie, Ill.
Relay—26,348—R B-B-M Div., Essex Wire Corp., Logansport, Ind.
Indicator, azimuth-range—456,949—Motorola, Inc., Chicago, Ill.

(*Continued on page* 132)

NEW SINGLE LENS

GRAY TELOJECTOR

STAR PERFORMER....



for TV commercials

Precision Projection

BETTER Commercials at LOWER COST

Yes . . . **now** you can use better 2" x 2" transparencies in uninterrupted sequence at lower cost. Important too, Gray Telojector is low in initial cost . . . ideal for budget-minded program directors. Telojector is compact, light weight, trouble-free. Two turrets take up to 12 slides at one loading. Additional loaded turrets are substituted in a matter of a few seconds . . . providing unlimited continual sequence. Controlled locally at the unit or remotely at the master video console. Also, can be used with the Gray 35B Manual Control Box to produce superposition, laps, fades and slide changes at any desired rate.

Complete Projection System

The New Gray 3B Telojector (2" x 2" Transparency Slide Projector) utilizes a single lens —permits superposing of two images on an optical axis . . . eliminates any need for external registration adjustment. The improved unit provides positive focusing of images on the camera tube with an uninterrupted sequence of slides for television commercials, news flashes and photographs or station and sponsors' identification.

GRAY RESEARCH

AND DEVELOPMENT CO., Inc., Hilliard St., Manchester, Conn.
Division of the GRAY MANUFACTURING COMPANY
Originators of the Gray Telephone Pay Station and the Gray Audograph and PhonAudograph.

WRITE FOR:

Illustrated, detailed information on the NEW, SINGLE LENS GRAY TELO-JECTOR and complete line of Gray Television - Broadcasting Equipment.

"Pig Tailoring" Speeds Manufacture

BRUNO-New York Industries Corp., New York City, has developed a technique, and associated equipment, to simplify the process of assembling resistors, capacitors, diodes and other axial lead components, as well as sleeved or bare wire jumpers; simultaneously reducing labor cost and increasing quality. The production technique is titled "Pig-tailoring," and is practical for both short and long run production.

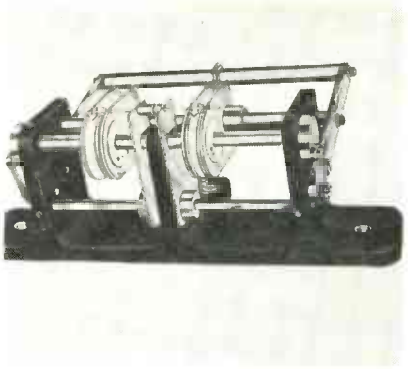


Fig. 1: Foot-operated machine for lead tailoring now being manufactured

The process breaks down into two prime steps; namely, (1) Preparation and (2) Assembly; and is applied to the incorporation of axial pigtail components in electronic assemblies, with either standard or turret type terminals or printed circuit board holes.

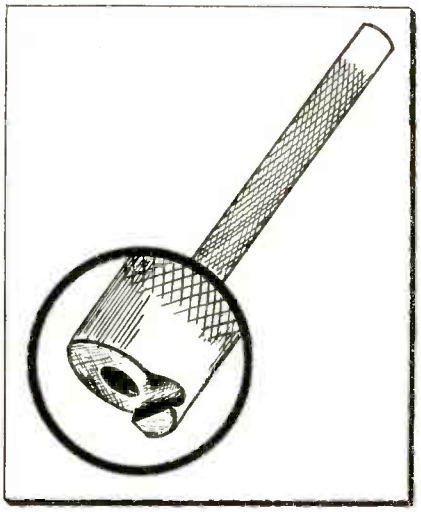


Fig. 2: Tool for fast and uniform spinning of tailored component leads on terminals

Preparation

Preparation, or lead-tailoring, is the combined operations of accurately measuring, cutting and bending of standard component leads, or pig-tails, and sleeved or bare wire jumpers, to enable uniform assembly.

To accomplish lead-tailoring, a small foot-operated machine (Fig. 1) is being manufactured by Bruno-New York Industries Corp. under the trade name "Pig-Tailor." It is capable of simultaneously and accurately measuring, cutting and bending *both* axial leads of any component at the average rate of 750 units per hour. Both leads can be cut to any individual length and bent at any desired point at right angles to the axis, either in the form of a "U" or an "S." No accessory fittings or attachments are required. The machine is completely flexible and adjustable to any cut, bend and shape within a maximum set-up time of 3 minutes. Any component of 1 in. diameter or less and not exceeding 6 in. overall, including uncut leads, can be processed.

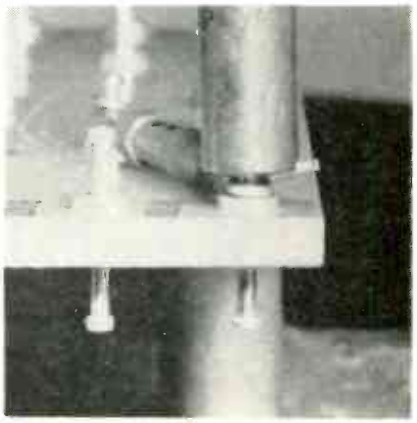


Fig. 3: Use of spinner with tailored components eliminates excessive lead tautness

In operation, the body of the component or wire jumper is placed between the two guide supports which are adjustable to any body length. The component leads fall into the aligned notches of both sets of shearing and bending elements, before the foot pedal is depressed. Depressing the foot pedal drives the keyed drive shafts, on the left and right sides of the center support, through a double reversible linkage, thus rotating both sets of shearing and bending elements. The direction that each keyed shaft drives is dependent upon the position of one drive link at each end of the machine. It is the independent direction change of these two links that provides for the "S" or "U" formed leads.

Shifting of one or both links by relocation of a screw in the eccentric

LOCKHEED SUPER CONSTELLATION

ASTRON AF-263
Subminiature Filter

Under every
environmental extreme
—dependable operation.

Find out today
how Astron can reduce
your filter costs . . .
write for
your personal copy
of the new
Astron
filter catalog NOW!

How to SILENCE four throbbing hearts...

In each engine nacelle of the World's Longest Range Airliner — the Lockheed Super Constellation — are electrical fuel pumps . . . the airliner's four throbbing hearts.

Constant pumping action of these units sets up pulsing interference in the Constellation's radio equipment . . . upon which the well being of 99 passengers depends. The electrical interference from these four pumps must be filtered out for good . . . a unique R.F. noise suppression filter is required, one tough enough to withstand extensive temperature changes, constant high engine heat, the freezing cold of high altitudes, rapid changes in atmospheric pressure, successive acceleration and deceleration plus the twisting, ripping vibration set up by each engine's torque.

Lockheed handed this "toughie" to Astron, recognized leader in the development and manufacturing of high quality R.F. interference filters. Astron's engineers had developed a subminiature filter with solid dependability that significantly cut maintenance and replacement cost. So successful and versatile is this Astron filter that the USAF now uses a similar hermetically sealed unit in one of its "drone" target planes, who's exact flight performance is governed by the clarity of the radio control signals received.

Efficient and economical solutions to complex interference problems like these have become commonplace over the years at Astron . . . whether you require a conventional unit or a unique type—rely on Astron to recommend or develop the proper design to fill your most exacting specifications. Astron "know how" gives you true filter miniaturization with an absolute minimum of size, weight and volume achieved through a highly successful combination of miniaturized elements with most modern design concepts, and construction techniques.

ASTRON
CORPORATION
255 GRANT AVENUE, E. NEWARK, N. J.

Export Division: Rocke International Corp., 13 East 40th St., N. Y., N. Y. In Canada: Charles W. Pointon, 6 Alcina Ave., Toronto 10, Ontario

Pig Tailoring

(*Continued from page* 120)

drive collar at each end will provide complete direction change. Each of the shearing and bending elements has key-slotted bushings that enable sliding adjustment from the center to each end of the machine and a single Allen set screw to fix their ultimate cutting and bending positions. Each of the shearing and bending elements consists of notched fixed and rotary members. Due to the relative positions of the leading edges of the shearing elements to the leading edges of the bending elements, the shearing is accomplished first, followed by the bending. The production models of the lead-tailoring machine include an ejection device.

The lead-tailoring operation can be taught to an unskilled operator within one hour, and with less than one day's experience a production rate such as mentioned above can be expected.

Assembly, the second step in the process, utilizes another device, titled "Spin-Pin," see Fig. 2. The essential purpose of this companion tool is for fast and uniform spinning of tailored component leads, around turret type terminals. It eliminates the need for longnose pliers and the contingent training and skill required for their use.

The use of the spinner (Fig. 3) with tailored components, eliminates excessive lead tautness and broken components. The tailored lead wire can be completely spun on the terminal, leaving no protruding end to be clipped. Either clockwise or counterclockwise turns can be applied.

The important element in the design and operation of the lead-spinning tool is the spiralling of the end of the lead over the adjacent section of the same lead.

The equipment described here has seen two years of constant use on the production line without maintenance of any kind. It is rugged, completely adjustable, requires no power supply, and can be easily arranged for air operation and equipped with a counter.

IRE Show Adds Space

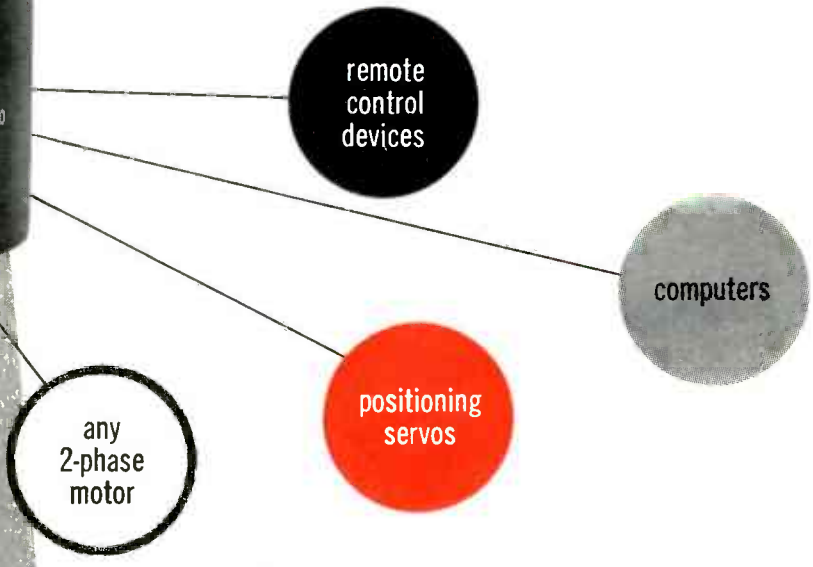
700 radio-and-electronic firms will exhibit in the 1955 Radio Engineering Show, Mar. 21-24, a gain of 16% over 1954. A large skating rink on Jerome Avenue, .2 mile south of the Kingsbridge Armory, will have additional exhibits. The 1956 Convention will be at the new New York Coliseum.

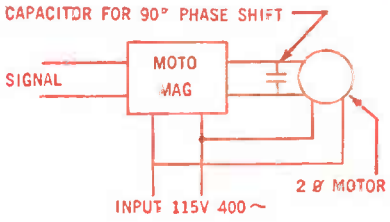
Keystone announces...

a new tubeless MOTO MAG

Now, from the world's leading producer of magnetic amplifiers... a new tubeless two-stage magnetic amplifier of saturable transformer type

3⅜" high x 2¼" deep x 2⅝" wide • mounting dimensions 1⅝" x 1¾" chassis cutout 1" diameter weight 1¾ lbs.





power input 115 volts 400 cycles output 115 volts 6 watts AC phase reversible • output at zero signal 1.5 volts maximum signal for full output 800 microamps • control circuit resistance 2800 ohms • response 63% .06 seconds • phasing capacitor .4 microfarads temperature range −40°C. to +100° C. • AC control available on special order

Newest members of the famous MOTO MAG family, these improved models offer several unique advantages:

- *In many applications they eliminate use of a pre-amplifier*
- *Smaller size — fit into more installations*
- *Operate on a smaller signal*
- *Self-contained phase detector*
- *Incorporate high-temperature germanium diodes for high operating temperatures*

These hermetically sealed units provide precision variable phase power control with a minimum of size and weight. Six standard models available — each can be quickly and economically adapted to meet your individual specifications.

PRICES:
1-24, $58 ea.; 25-49, $40 ea.; 50-99, $35 ea.; 100-299, $32 ea.; 300-499, $30 ea.; 500-999, $28 ea.; 1000-2500, $27 ea.

Write today for complete specifications, performance data, and quotes to meet your specific application.

keystone PRODUCTS COMPANY

905 23RD. STREET • UNION CITY. 2. N. J. • UNION 6-5400

CONTI

PERSONAL

D. C. Perrine, Jr. has been appointed director of engineering of the Pacific Div. of Bendix Aviation Corp. Mr. Perrine was formerly ass't mgr. and chief engineer of Consolidated Vultee Aircraft Corp.'s Pomona Div.

Lionel Wittenberg, formerly remote supervisor for WCCO-TV, Minneapolis, has been named chief engineer of WTVW, Milwaukee.

William W. Garstang has joined the Allen-Bradley Co. as chief engineer of the radio division.

W. W. Garstang

P. D. Williams

Paul D. Williams has been appointed chief of ceramic development for Eitel-McCullough, Inc., San Bruno, Calif. electron tube mfr.

Robert M. Floyd, Charles H. Schardin, Luther W. Maples, Jr., Malcolm R. Currie, Howard T. Ozaki, Shirly LaVar Howard, Philip J. Fleeman and **Alan J. Schinnerer** have joined the electrical engineering staff of Hughes Research & Development Labs.

Ralph L. Palmer has been appointed director of engineering of International Business Machines Corp. Also appointed at I.B.M. was **John C. Abrams** to the post of director of laboratory operations.

Dr. Ragnar Thorensen has become director of research at Magnavox Corp. and will head the company's new research and engineering lab.

Charles M. Young has been appointed manager of engineering at the General Electric Industrial and Transmitting Tube Sub-Department in Schenectady, to succeed **Albert C. Gable** who has been named manager of product planning for the sub-dept.'s marketing section.

William C. Cothron has joined the technical sales staff of Prodelin, Inc., Kearny, N. J.

C. J. Bachman has become Theatre Equipment Prods. Mgr. of Fairchild Recording Equipment, Whitestone, N. Y.

(*Continued on page* 126)

Balanced-Line measurements!

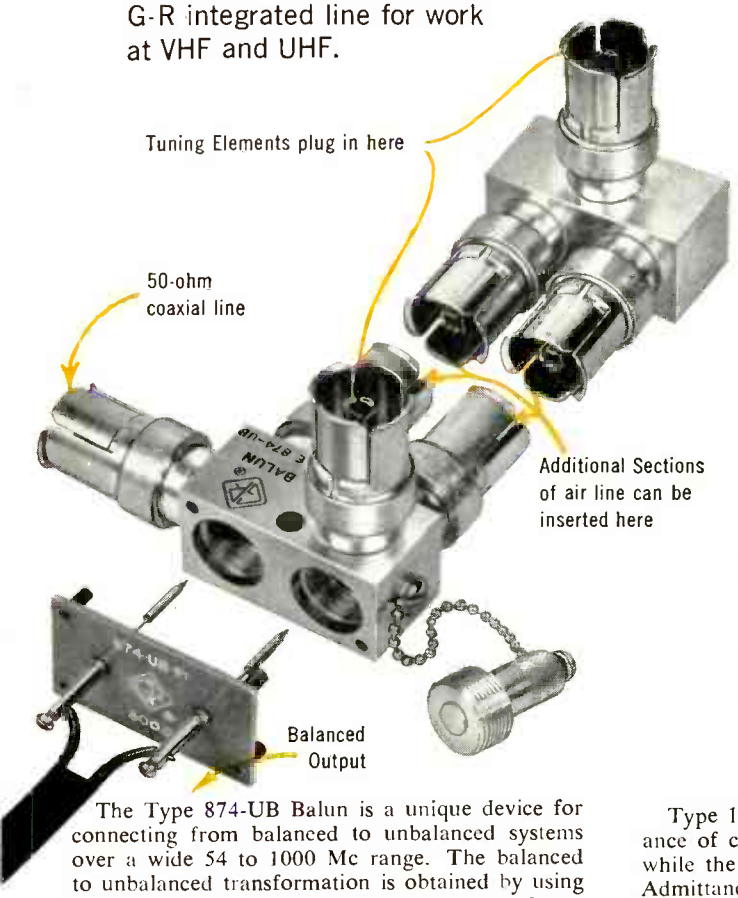
VHF-UHF TUNABLE BALUN

Used with the G-R Admittance Meter

and New G-R High-Frequency Null Detector . . .

The G-R High-Frequency Measuring System is useful for many types of measurements on both balanced and unbalanced circuits.

Write for our bulletins describing the Admittance Meter, Slotted Line, Balun, High-Frequency Detector and many other instruments of the G-R integrated line for work at VHF and UHF.



The Type 874-UB Balun is a unique device for connecting from balanced to unbalanced systems over a wide 54 to 1000 Mc range. The balanced to unbalanced transformation is obtained by using a semi-artificial, half-wave line made up of two sections of 50-ohm coaxial line and two shunt tuning elements.

The Balun is made tunable so that the best possible accuracy can be obtained at any frequency over its range. This unit is precision tooled and is of the same high caliber workmanship which has become synonymous with the G-R trademark.

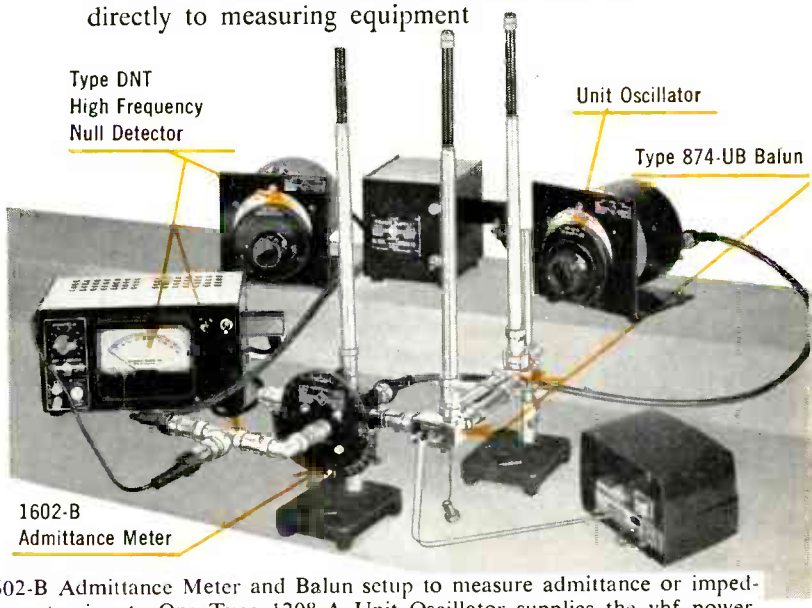
. . . makes possible accurate impedance, VSWR, gain and sensitivity measurements on balanced systems

. . . converts grounded signal generators to signal sources with balanced outputs

. . . permits accurate measurement of attenuation as well as impedance of balanced twin-lead, twin-line, other tv transmission lines, and on tv receiver inputs and other communication equipment. Write for the booklet "The Measurement of Cable Characteristics"

. . . determines VSWR introduced into 300-ohm twin-lead by filters, lightning arrestors, etc.

. . . facilitates measurement of inaccessible balanced circuits such as tv receiving antennas which cannot be connected directly to measuring equipment



Type 1602-B Admittance Meter and Balun setup to measure admittance or impedance of converter input. One Type 1208-A Unit Oscillator supplies the vhf power, while the local oscillator in the Type DNT Null Detector Assembly beats with the Admittance Meter output to provide a 30-Mc difference frequency. This signal is detected by the new Type 1216-A Unit I-F Amplifier, also an element of the Null Detector Assembly.

874-UB Balun	$75.00
For use with the Balun	
874-D50 Adjustable Stub (50 cm)	12.00
874-L10 50-ohm Coaxial Air Line (10 cm)	5.00
874-L20 50-ohm Coaxial Air Line (20 cm)	5.50
1602-B Admittance Meter and accessories	295.00
Type DNT Detector Assembly . . . available with appropriate local oscillators for coverage from 50 Mc to 950 Mc on fundamental frequencies and to 5000 Mc using oscillator harmonics . . . $628 to $667 depending on frequency range	

Unit Oscillators

1211-A	500 kc to 50 Mc	$295.00
1215-B	50 to 250 Mc	190.00
1208-A	65 to 500 Mc	190.00
1209-B	250 to 920 Mc	235.00

WE SELL DIRECT – Prices are net, FOB Cambridge or West Concord, Mass.

ADMITTANCE METERS
AMPLIFIERS
COAXIAL ELEMENTS
DISTORTION METERS
FREQUENCY MEASURING APPARATUS
FREQUENCY STANDARDS
IMPEDANCE BRIDGES
LIGHT METERS
MEGOHMMETERS
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MOTOR CONTROLS
NULL DETECTORS
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PARTS & ACCESSORIES
POLARISCOPES
PRECISION CAPACITORS
PULSE GENERATORS
R-L-C DECADES
R-L-C STANDARDS
SIGNAL GENERATORS
SOUND & VIBRATION METERS
STROBOSCOPES
TV & BROADCAST MONITORS
U-H-F MEASURING EQUIPMENT
UNIT INSTRUMENTS
VARIACS®
V-T VOLTMETERS
WAVE ANALYZERS
WAVE FILTERS

GENERAL RADIO Company

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920 S. Michigan Avenue CHICAGO 5
1000 N. Seward Street LOS ANGELES 38

PERSONAL

(Continued from page 124)

Arnold E. Linton has been promoted to the post of mgr. of the RCA tube mfg. plant at Woodbridge, N.J.

Hans Thurnauer has become technical consultant on ceramics and electrical insulations for Minnesota Mining & Mfg. Co. In addition, he continues as vice president of American Lava Corp., a 3-M subsidiary.

Arthur E. Harrison has assumed the position of director of engineering for Fairchild Guided Missiles Div. He was formerly vice-president in charge of engineering at Wilcox Electric Co., Kansas City, Mo.

A. E. Harrison

K. C. Black

Dr. K. C. Black has been appointed director of Raytheon Mfg. Co.'s communications and engineering dept. He was formerly business mgr. of Polytechnic Res. & Dev. Co. of Brooklyn, N. Y.

Lawrence A. Hyland has been appointed vice president and general manager of Hughes Aircraft Co. Previous to accepting this position he was vice president in charge of engineering at Bendix Aviation Corp.

Dr. James Hillier has joined the research and engineering staff of Radio Corp. of America as an administrative engineer. His office will be in the David Sarnoff Research Center, Princeton, N.J.

J. Hillier

R. D. Kell

The Society of Motion Picture and Television Engineers has named **Ray D. Kell** recipient of the 1954 David Sarnoff Gold Medal Award. Mr. Kell is a member of the TV research staff of RCA Labs.

Weston Model 981
Proportional Mutual Conductance Tubechecker

FILTERED D-C POTENTIALS

for accurate G_m measurements

OUTSTANDING FEATURES:

G_m MEASUREMENTS—G_m measurements are made more accurately by using filtered d-c plate, screen grid and control grid potentials. A precision voltage divider network and selector switch allows a proportionate value of signal voltage to be chosen *for testing tubes having transconductances up to 30,000 micromhos*. Signal voltages of 5.2, 2.6, 1.3, and 0.65 volts peak-to-peak having a frequency of 5000 cycles are provided.

GRID BIAS, SCREEN GRID AND PLATE VOLTAGE: Filtered d-c potentials of 90, 130, and 220 volts are available for plate and screen potentials. A variable filtered d-c voltage in two ranges of 0-5 and 0-20 volts are used to obtain better resolution of Grid Bias settings. *Far greater accuracy is obtainable with filtered d-c potentials than previously possible in portable tubecheckers.*

METER MEASUREMENT OF HIGH LEAKAGE RESISTANCE—Since tube leakage as high as several megohms can cause poor performance in TV Receivers, this tubechecker is designed to provide an accurate meter measurement of leakage resistance as high as 5 megohms between tube elements, thus being particularly useful for TV servicing and TV line production assembly.

TWIN SECTION TUBES—Three toggle switches make it possible to rapidly check and compare the respective sections of twin section tubes at only one setting of the selector switches.

WESTON *980 LINE TEST EQUIPMENT*

THE 980 LINE PROPORTIONAL MUTUAL CONDUCTANCE TUBECHECKER

SEND COUPON TODAY FOR COMPLETE DESCRIPTION AND PRICES

Weston Electrical Instrument Corporation
614 Frelinghuysen Avenue
Newark 5, New Jersey

Please send literature on the new 981 Tubechecker.

NAME_____

ADDRESS_____

_____

TT

BULLETINS

Coaxial Cable Connectors

Catalog 201, presents those coaxial connectors most frequently needed in standard applications; also, special and difficult-to-produce items. Indexed cross-references and tabbed section pages. Illustrations approximately actual size. Issued by Dage Electric Co., Inc., Beech Grove, Ind. (Ask for B-12-3)

Phase Meter

The Industrial Test Equipment Co., 55 E. 11th St., New York 3, N. Y. has a brochure available that covers the Model 200A phase meter. Gives principles of operation, features and specifications. (Ask for B-12-38)

Isolators

The new 8-page Bulletin #541, issued by Barry Corp., 1000 Pleasant St., Watertown, Mass., gives information on the load ranges of the type 5200 shock and high vibration isolators designed for marine, transportation, and industrial applications. (Ask for B-12-39)

Pilot Lamps

A new brochure, Form L-155, on "Selection and Application of Pilot Lights," treats of the subject in two main sections—pilot light lamps, and pilot light assemblies. Issued by Dialight Corp., 60 Stewart Ave., Brooklyn 37, N. Y. (Ask for B-12-33)

Gas Analyzers

Charles Englehard, Inc., 850 Passaic Ave., E. Newark, N. J., have released an illustrated brochure that discusses gas analyzers for thermal conductivity measurements. (Ask for B-12-34)

Carrier Amplifier

A new bulletin, issued by Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena, Calif., covers the applications, features, and specifications of the carrier amplifier system, Type 1-127. Technical information is also available on the Type 3-122A 24 v. dc power supply and the Type 3-132 low voltage dc power supply. (Ask for B-12-35)

Closed Circuit TV

"How To Read A Blueprint at 500 Feet," by Radio Corp. of America, Engineering Products Div., Camden, N. J., describes the simplicity and functions of "TV Eye," low-cost, closed-circuit TV equipment. Request form 3R2436. (Ask for B-12-36)

Magnets

"Applied Magnetics," Vol. 2, No. 5, carries the article, "How Magnetic Testing Helps Maintain Your Quality Standards," by Gerald T. Barta, quality control manager of The Indiana Steel Products Co., Valparaiso, Ind. Copies are available to readers who send requests to the company. (Ask for B-12-29)

Frequency Meter

A data sheet with accompanying technical information, prepared by Colortone Electronics, Inc., 238 William St., New York, N. Y., illustrates and describes the TS-175 A/U frequency meter. (Ask for B-12-30)

Yoke Winder

A catalog page illustrating and describing the new Model YW series deflection yoke winder was recently issued by Geo. Stevens Mfg., Co., Inc., Pulaski Rd. at Peterson, Chicago 30, Ill. Gives complete technical data. (Ask for B-12-31)

Air Data Computer

An 8-page technical brochure released by Servo-mechanisms, Inc., Post & Stewart Aves., Westbury, N. Y. or 316 Washington St., El Segundo, Calif., discusses the "Master" air data computer and presents schematic diagrams showing how the plug-in type computer solves complex calculations with a minimum of equipment. (Ask for B-12-32)

Microwave Noise Generator

A data sheet recently issued by Telechrome Inc., 88 Merrick Rd., Amityville, L. I., N. Y., describes the purpose and gives the specifications and features of the Model 1000 microwave noise generator. (Ask for B-12-25)

Kits

The new 1955 Heath catalog contains 48 pages covering more than 55 kits—test instruments, amateur equipment, Hi-Fi audio equipment, etc. Catalog contains complete specifications and schematics. Available on written request to Heath Co., 305 Territorial Rd., Benton Harbor, Mich. (Ask for B-12-26)

"Quad-Kards"

A four-page brochure released by Methode Mfg., Co., 2021 W. Churchill St., Chicago 47, Ill., presents engineering details and suggested applications for dimensionally standardized printed circuit panels. (Ask for B-12-2)

Printed Circuits

CMS printed electrical circuits are discussed in a 2-page illustrated technical data sheet that announces that additional information is available at Cleveland Metal Specialties Co., 1753-83 E. 21st., Cleveland 14, O. (Ask for B-12-28.)

Mass Spectrometer

Bulletin CEC-1824A, prepared by CEC Instruments Inc., subsidiary of Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 15, Calif. describes and presents performance characteristics of the Model 21-610 mass spectrometer. (Ask for B-12-21)

Transformers

The 1954 "Stancor" catalog lists replacement and new equipment transformers with complete electrical and physical specifications on over 500 units. Sixty-five—TV and exact duplicate auto vibrators—are listed for the first time. Chicago Standard Transformer Corp., Addison and Elston, Chicago 18, Ill. (Ask for B-12-22)

Hermetic Terminals

Bulletin No. 5410, prepared by American Lava Corp., Chattanooga 5, Tenn., gives the latest information on "AlSiMag" metalized hermetic terminals. Includes property chart (Ask for B-12-23)

"Lumiline" Screen

Complete details covering the improved version of the "Lumiline" screen, used to measure projectile speeds, etc., are available at Industrial Instruments, Inc., 89 Commerce Rd., Cedar Grove, N. J. (Ask for B-12-24)

Thickness Tester

Bulletin No. 159, prepared by Gardiner Laboratory Inc., 4723 Elm St., Bethesda 14, Md., illustrates and describes the features of the "Handi-Gage," a pocket magnetic thickness tester for electrodeposited, hot-dipped or painted coatings on steel. (Ask for B-12-17)

Resistor

Engineering Bulletin L-33, issued by Shallcross Manufacturing Co., Collingdale, Pa., gives charts, tables, and dimension on all performance characteristics of "Borohm" boro-carbon resistors. Also discusses straight deposited-carbon resistors. (Ask for B-12-18)

Military Television

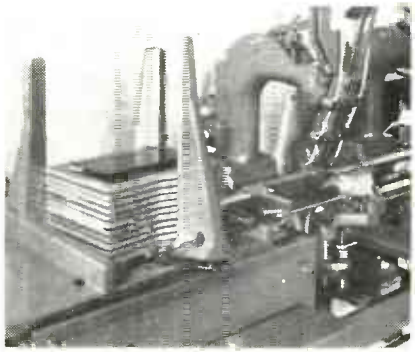
Military Television is title of new booklet of unusual interest available from Dept. of Information, Radio Corp. of America, RCA Building, 30 Rockefeller Plaza, New York 20, N. Y. The text, illustrated with photos and diagrams reviews the first public demonstration of combat television at Ft. George G. Meade, Maryland, August 11, 1954. (Ask for B-12-37)

OBTAIN THESE BULLETINS

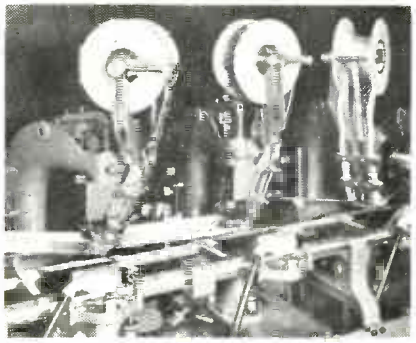
described here by writing on company letterhead to Bulletins Editor, TELE-TECH & ELECTRONIC INDUSTRIES, 480 Lexington Ave., New York 17, N.Y., listing numbers given at end of each item of interest. Please mention title of position held.

On Automatic Production

(Continued from page 116)

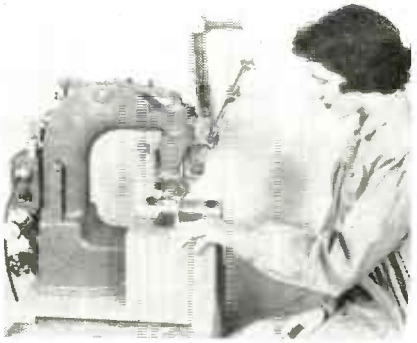


Pre-punched PW boards are accurately located in metal pallets or frames in which they travel from loading station shown here through the machine. Precision machining of pallets assures accurate board locating under inserting heads



Each inserting station automatically feeds, prepares, and inserts components through pre-punched holes in p-w boards. Auxiliary lead straightening and belting machine facilitates handling of components with pig-tail leads

Inserting heads are readily adjustable and can insert components anywhere on p-w board



Inserting heads can also be used independently as bench-type units where small volume or specialized nature does not justify use of complete machine

News of MANUFACTURERS' REPS

Bob McClendon, 3907 Central Ave. E., Albuquerque, N. M. has been appointed rep in New Mexico and Ariz. for Cinema Engineering Co. Div. of Aerovox.

Wayne M. MacEachern has joined the staff of **Tubergen Assoc.**, 2232 W. 11th St., Los Angeles, Calif. to handle office sales.

D. Dolin Sales, with offices at 1200 N. Ashland Ave., Chicago, Ill., has been appointed Chicago industrial rep for Elco Corp., Philadelphia, Pa., and **Robert T. Brown**, Merchandise Mart, Chicago, will handle jobber sales in Chicago, and industrial sales in downstate Ill. **Lowry & Dietrich Co.**, located at 1404 Swantek St., Pittsburgh, Pa., has been appointed to handle western Pa. and W. Va. jobber and industrial accounts.

Norman B. Neely (l) head of Neely Enterprises, 7422 Melrose Ave., Los Angeles, Calif., announces that his firm has been appointed rep for the Industrial Div. of Sanborn Co., mfr. of oscillographic recording systems.

R. Donald Weir, sales rep for Audio Development Co. has moved his office to 214 Main St., Hackensack, N. J., telephones DIamond 3-4118 and WIsconsin 7-2385.

Permoflux Corp., Chicago, Ill. has appointed **E. Alvin Rich** exclusive rep for their line of speakers, headsets, microphones and transformers in the New England area. Mr. Rich's offices are at 49 Homestead Ave., W. Springfield, Mass.

Rockbar Corp., of New York has become national distrib for Goodmans Industries Ltd. of England, manufacturer of loudspeakers.

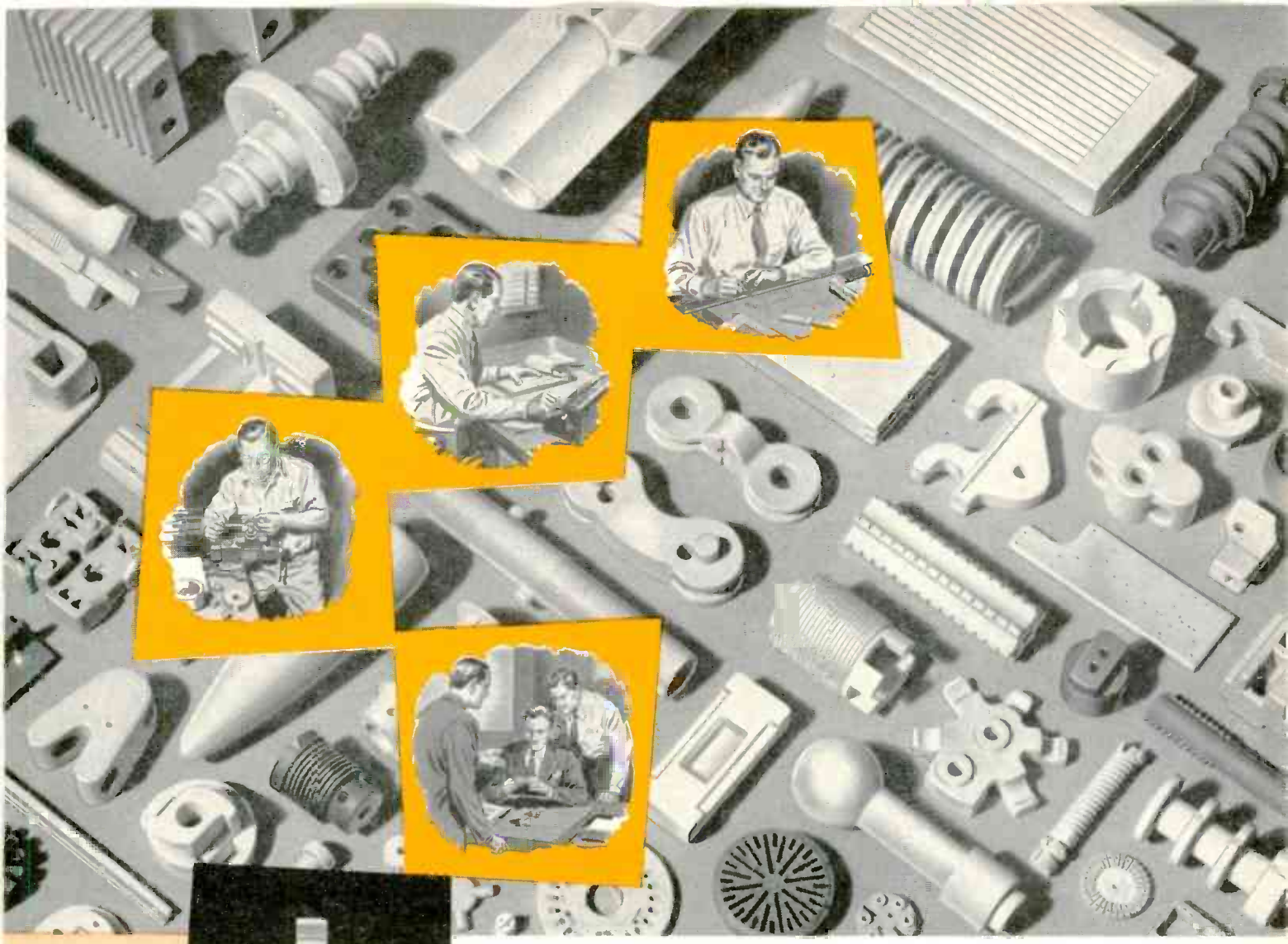
Dunvar Inc. of Chicago, Ill., has been named midwestern rep for Condenser Products Co., div. of New Haven Clock Co., Conn., and will handle that company's line of capacitors, high voltage power supplies and pulse forming networks.

At the last regular meeting, the following members were elected officers of the New York Radio & Television Square Club for the ensuing year: **James I. Benjamin**, Pres., **Arthur J. Bauer**, V.P., and **Abe Schneiderman**, Secy. **John J. Kopple**, 60 E. 42nd St., New York 17, was chairman of the nominating committee.

Military Contract Awards

(*Continued from page* 118)

Data Recording System—42,867—G M. Giannini & Co., Inc., 580 Fifth Ave., New York, N. Y.
Test Set, multi-purpose—88,327—Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.
Handsets, telephone—76,600—United States Instrument Corp., 409 Broad St., Summit, N. J.
Parts, controller assy—40,226—Chicago Aerial Survey Co., 1980 Hawthorne Ave., Melrose Park, Ill.
Recorder-Reproducer—75,873, Webster Electric Co., Racine, Wis.
Transformers, silicon—326,680—Texas Instruments, Inc., 6000 Lemmon Ave., Dallas 9, Texas.
Tube, electron—41,172—Radio Corp. of America, Harrison, N. J.
Tube, electron—222,288—Sperry Gyroscope Co., Div. of Sperry Corp., Great Neck, N. Y.
Battery, dry—464,344—Ray-O-Vac Co., 212 E. Washington Ave., Madison, Wis.
Battery, dry—558,351—Burgess Battery Co., Freeport, Ill.
Battery, dry—289,620—P. R. Mallory & Co., Inc., 60 Elm St., N. Tarrytown, N. Y.
Motor Generator Set—55,076—Regulator Equipment Corp., Paterson, N. J.
Tube, electron—31,779—General Electric Co., Tube Dept., 1 River Rd., Schenectady, N. Y.
Tube, electron—103,008—Varian Associates, 611 Hansen Way, Palo Alto, Calif.
Tube, electron—78,750—Bomac Laboratories, Salem Rd., Beverly, Mass.
Tube, electron—27,525—Bomac Laboratories, Inc., Salem Rd., Beverly, Mass.
Tube, electron—49,750—Sylvania Electric Products, Inc., 1740 Broadway, New York, N. Y.
Rectifiers—140,580—General Electric Co., Wyatt Bldg., 777 14th St., N. W., Washington, D. C.
Test Unit—34,516—Mercury Manufacturing Corp., Plant 2, Electronics Div., Fourth & Montjoy St., Falmouth, Ky.
Receiving Sets, omni-range—149,872—Joppa Rd., Towson 4, Md.
Transistors, infrared photo—245,148—Transitron Electronics Corp., 403-407 Main St., Melrose, Mass.
Jamming Equipment—100,667—Melpar, Inc., 425 Swann Ave., Alexandria, Va.
Computer—40,885—Reeves Instrument Corp., 215 E. 91st St., New York 28, N. Y.
Battery, dry—209,205—National Carbon Co., 30 E. 42nd St., New York 17, N. Y.
Radio Set—846,921—Western Electric Co., Inc., 120 Broadway, New York, N. Y.
Tube, electron—32,592—Radio Corp. of America, Tube Div., Harrison, N. Y.
Rectifier, power unit—202,792—The Siltronic Co., 3126 Fobes St., 3126 Pittsburgh 13, Pa.
Tube, electron—88,006—Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
Battery, dry—44,253—Olin Matheison Chemical Corp., Electrical Div., 275 Winchester Ave., New Haven 4, Conn.
Jack, telephone—140,639—Conn. Telephone and Electric Corp., 70 Britannia St., Meriden, Conn.
Battery, dry—304,171—Ray-O-Vac Co., 212 Washington Ave., Madison 10, Wis.
Meter—29,536—Revere Corp. of America, 845 N. Colont Rd., Wallingford, Conn.
Amplifier—52,186—Chicago Aerial Survey Co., 1980 Hawthorne Ave., Melrose Park, Ill.
Regulator—61,298—General Electric Co., 1405 Locust St., Philadelphia, Pa.
Radio Set—1,488,975—Lewyt Mfg. Corp., 60 Broadway, Brooklyn 1, N. Y.
Tube, electron—25,556—Sylvania Electric Products, Inc., 1740 Broadway, New York, N. Y.
Switchboard signal—13,100—North Electric Mfg. Co., 501 S. Market St., Galion, Ohio.
Communication equipment, radio—60,363—Collins Radio Co., 855-35th St., Cedar Rapids, Ia.
Comparator Group—60,192—Vectron, Inc., Waltham, Mass.
Relay—96,797—Phillips Control Corp., 59 W. Washington St., Joliet, Ill.



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Transistor Standard

(*Continued from page 91*)

in the schematic of Fig. 6. Coupling and differentiation is obtained by the .005 μf condensers. The transistor is biased below cutoff so that the output of one divider will just cause conduction. If the output pulses from

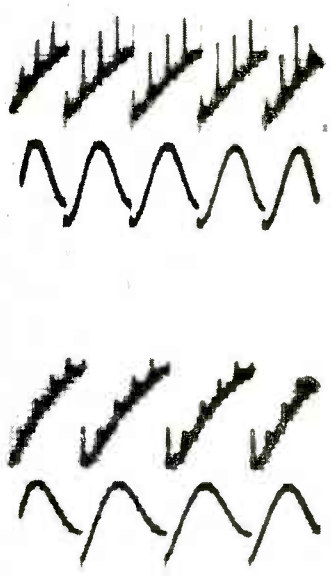


Fig. 7: (a—top) Normal emitter and base waveforms of second divider. (b—bottom) Normal emitter and base waveforms of third divider

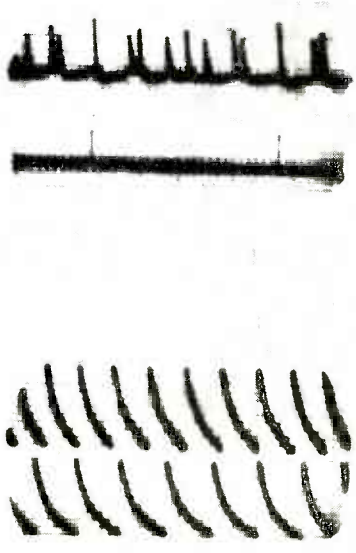


Fig. 8: (a—top) Emitter and collector waveforms of coincidence circuit. (b—bottom) Collector waves of two circuits feeding coincidence stage

both dividers arrive simultaneously, full output of slightly over 11 v is obtained for the duration of these pulses. See Fig. 8A, which shows a dual beam oscillogram of the coincidence transistor input and output. At first glance, it may seem that the oscillogram indicates that the transistor is saturated except when co-

incidence occurs. However, it should be remembered that the base line of the collector waveform in Fig. 7A is −12 v and not zero. As temperature increases, I_{co} or collector current with no emitter current, increases. Thus, in order to maintain collector current cutoff, more bias current is required and is obtained through a thermistor whose resistance is an inverse function of temperature.

Conclusions

The transistor low frequency standard delivers an 11 volt positive pulse into a low impedance load with an accuracy of better than 1 part in 10^4 from −40 degrees F to +140° F.

Transistor selection is necessary, particularly of point contact units used in the divider circuits if optimum results are to be obtained. Almost any junction transistor can be used providing it supplies the desired gain.

Elgin Buys Neomatic

Elgin National Watch Company has announced that it has entered the fast growing West Coast electronics manufacturing field with the outright purchase of Neomatic, Inc., specialists in development of miniature electronic components. The acquisition marks Elgin's first major step in product diversification since the company announced late in 1953 its intention of entering the growth fields of miniature electronic components and automatic production instruments. Neomatic's plant has concentrated on special purpose relay switches.

16mm Magnetic Sound for Video Film

In a technical paper delivered before the 76th semi-annual convention of SMPTE, Edward Schmidt of Reeves Soundcraft, Inc., New York, described the new "Magnastriper" equipment as the 16mm version of the 35mm equipment which produces the magnetic stereophonic sound on CinemaScope motion pictures. Widespread use of the new equipment in the television industry was foreseen. Speed of operation permits commercial quantities of striping, at least 10,000 ft., eight-hour day. It permits handling of all three types of 16mm magnetic striping, including double perforated, 100 mil, and half-stripe single perforated films.

I-F Transformers

(Continued from page 87)

the Q of the coil was greatly influenced by the position of the slug. Also, the coefficient of coupling was affected by the slug position. As a result, it was practically impossible to reproduce the transformers to closely controlled bandwidths. The resonant impedance of the coil and capacitor alone was roughly 25,000 ohms. The 68,000 ohm resistor

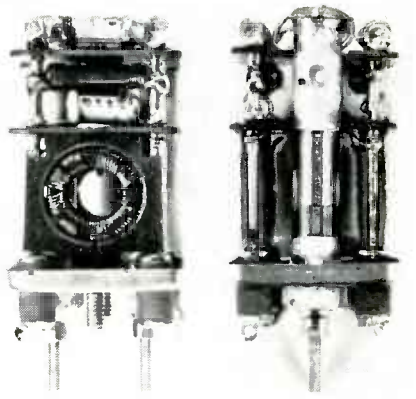


Fig. 3: (l) I-F transformer construction details, showing toroidal coil and resistors. Fig. 4: (r) View showing unit's plunger capacitor

shunted the resonant impedance resulting in a net impedance of 18,000 ohms. The composition loading resistor was in itself guilty of undesirable effects. For one thing, there is as much as 25% discrepancy between the effective r-f resistance and the dc resistance, the actual value of this discrepancy varying with the manufacturer, wattage, and so on so that unless each resistor is measured, the loaded Q is quite unpredictable.

The fact that the resistor was more stable than the resonant impedance of the coil suggested the corrective technique to reduce the temperature effects. In the case of the first transformers the coil represented the lower impedance than the resistor, hence the temperature coefficient of impedance of the loaded resonant circuit was primarily controlled by the coil. If the resonant impedance of the coil could be made higher by increasing the Q, a lower value of shunt resistor could be used to restore the design Q of 50.

After some experimentation, a coil was wound on a powdered iron toroidal form which had a Q of 150. Instead of 68,000 ohms of loading resistance, a 30,000 ohm loading resistor was required across the coil to obtain the design Q of 50. In this case the resonant impedance of the unloaded coil is 50,000 ohms and this impedance when shunted by 30,000

ohms is exactly equivalent to the 18,000 ohm impedance of the original transformer. Obviously, this change is a step in the right direction since the temperature coefficient of the resistor is now dominant. As a dividend of this toroidal coil arrangement, the temperature coefficient of the unloaded Q was found to be only ⅓ as great as the temperature coefficient of the slug-tuned solenoid coil. In addition, the toroid is not affected by the proximity of a nearby metal shield. These benefits outweigh the higher unit cost of the toroid.

Resistor Characteristics

The gain stability was now virtually dependent on the stability of the loading resistor. Considerable experimentation was conducted to determine the best type of resistor for use as the loading element. Deposited carbon film type resistors were found to be vastly superior to composition resistors for two reasons: the resistance changed only about 3% over a 100° C temperature range instead of the 6% change in the composition type. But equally important is the fact that the dc resistance and the r-f resistance are one and the same so that loading resistors may be calculated and installed without individually measuring the effective r-f characteristics, with assurance that the resultant Q will be within a few percent of the design value. A still more stable resistor is the boron-carbon film type which was found to change resistance less than 1% over the same 100° C temperature range. In addition, since it is a film type resistor, it retains all the other benefits of the deposited carbon resistors.

Fig. 5: Top view of i-f transformer

Model Transformer

A transformer was constructed with two toroids and boron-carbon loading resistors. Both circuits were

I-F Transformers

(*Continued from page* 137)

capacity tuned with plunger type capacitors so that tuning adjustments have no effect on the coefficient of coupling. Capacity coupling is used between primary and secondary. This transformer may be seen in Figs. 1, 3, 4 and 5. This transformer measures 1 in. square by 1⅝ in. high. The assembly is hermetically sealed. The construction is very rigid mechanically. The coupling capacity is approximately 1 μμf and since the bandwidth was to be controlled to within 2% in the development models, a 1-in. length of plastic encased twin-lead of a type frequently used in winding bifilar coils was installed for the coupling capacity. This capacitor is trimmed to the desired bandwidth with the transformer installed in a test jig. Of course, if the bandwidth tolerance is relaxed, a fixed coupling capacity may be used.

An amplifier using three of these transformers was constructed and evaluated. It was found that no gain change could be measured over a 125° C temperature range when testing under the same conditions which had shown a 2 to 1 change in i-f gain with the original solenoid type transformers. In addition, the response curve maintained its shape and symmetry.

Vehicular Transportation

(*Continued from page* 96)

self as a suitable instrument for simulating railroad shocks originating from rail joint discontinuities. It was found that the three table speeds, 240, 270 and 285 rpm, constitute a satisfactory simulation of different train speeds. Parts of "go" and "no go" Signal Corps tests, therefore, require equipment and components to be subjected to these table speeds. The highest and lowest speed were selected for the comparison test between the Package Tester and the wheeled vehicle.

Package Tester Results

Figs. 11 & 12 present the results obtained on the Package Tester. The transit case and the shock mounts provide protection for the electronic equipment, since the total acceleration values are smaller when the equipment is packed in the transit case. Because of the filter action of the shock mounts, the frequency distribution is shifted and the shocks

are amplified below 150 cps; however, a second peak in the acceleration curve occurs at about 370 cps

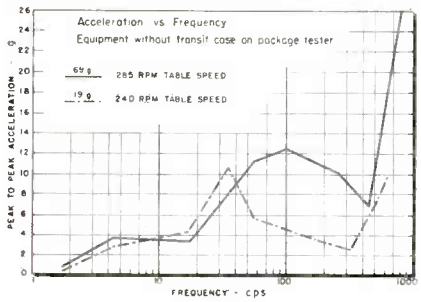


Fig. 11: Spectrum of equipment without transit case measured on package tester

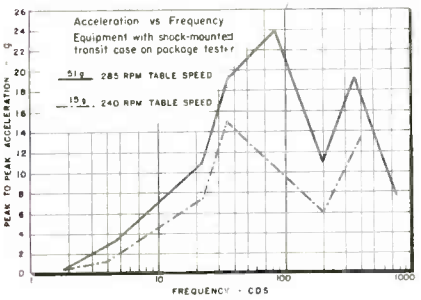


Fig. 12: Spectrum of equipment in shock mounted case measured on package tester

(see Fig. 12). This peak indicates that higher modes were excited, probably due to the rocking action which the equipment is subjected to on the package tester table.

Comparison of Figs. 10, 11 and 12 reveals that the conditions encountered on the package tester are different from those on the vehicle. It is obvious that the table speed of 285 rpm is too high since the overall accelerations are considerably in excess of those measured on the vehicle.

Overall Acceleration

At 240 rpm table speed, the overall acceleration encountered by the equipment without transit case is approximately equal to the acceleration measured on the vehicle (19 g and 21 g). But due to the higher modes excited on the package tester, the spectrum is different and thus the overall accelerations applied to the equipment when it is packed in the transit case differ considerably (15 g versus 11 g).

For better coordination between vehicle and package tester, it is necessary to change the operating conditions of the package tester; this probably could be done by decreasing its speed and increasing its stroke.

The authors wish to acknowledge the assistance rendered by Mr. H. K. Webber, Coles Signal Laboratory, SCEL, during the conductance of the tests.

Deflecting Coils

(*Continued from page* 83)

field turns out to be a squared cosine law.

Up to now, we have considered only the fields due to the active parts of the coils, that is the parts of the wires which lie parallel to the axis of the picture tube.

Unfortunately the coils comprise a part that is bent around the tube neck, the so-called "ends." Those ends are entirely unnecessary for the deflection itself, and create magnetic fields which interfere with the deflecting field and introduce unwanted distortions.

To reduce this end-effect, it is customary that the ends of the coils be bent up and away from the tube neck, but this results in longer wires and more copper. The efficiency falls then to 30 or 25% with yokes of the types 2b or 2c. As the outside (leakage) flux of a well designed coil is of the order of 10 to 15%, it will be seen that the total loss is of the order of 60% of the energy delivered to the yoke.

Another point is worth mentioning; it relates to the manufacturing difficulties of the ordinary types of deflecting coils. Unavoidable discrepancies will lead to marked variations in the distortions produced.

Field Measuring Apparatus

A detailed investigation of the field inside the yoke was made with the help of the apparatus shown in the photograph.

It consists essentially of a probe to measure the magnetic field intensity, and a means of supporting and moving the yoke, through which is sent a current.

The displacement of the yoke is precisely controlled, and the plotting of the fields is carried on in the usual manner, according to the three axes shown in Fig. 3.

For example, an ordinary yoke, type 2b or 2c, gives the fields of Figs. 3a, 3b, and 3c.

It is evident that a coil of the usual shape, shown in Fig. 4a, cannot be entirely free from end effects. The radical way to eliminate the end effects would be to eliminate the ends. This might sound silly, since the wire of the windings must be continuous to allow the current to pass, and a connection is necessary between any two active side wires. But it is not so silly when one comes to consider new forms of winding entirely different from Fig. 4a, and for example the form given Fig. 4b which can be considered as two in-

terlaced elliptical coils.

Before bending, such a set of coils, plane wound, looks like Fig. 4c. The directions of the currents are given by the arrows, and it will be seen that all the wire is active and that the currents combine two by two to give a conventional deflecting field.

The important point is that there are no ends, and hence no end effects. The mapping of the field for the crossed-fields coils is shown in Figs. 5a, b, c, with reference to Fig. 5 to identify the axes and the points of measurement.

Advantages of the New Coils

Comparison between Figs. 3c and 5c will show the difference between the two types of coils. It will be specially noticed how all end effect is absent on the right of Fig. 5c. The spot shape is, for the same reason, much better with the new coils. The gain in energy is also important: for the same deflection angle, a conventional coil has an average length per turn of 19 in., and an elliptical coil of only 14 in. This represents a 25% improvement.

The efficiency of the crossed-fields coils is higher because the losses are smaller, and also because the field is much more usefully distributed inside the tube neck; this last point is supported by comparison between Figs. 3a and 5a.

To give an idea of the improvement, a cross-fields yoke without core gives the came deflection as a conventional yoke with a high permeability ferrite core.

Printed Crossed-fields Coils

A very important thing, from a practical point of view, is that the new type of coils is particularly suited to printing methods, especially for coils of medium or high impedances. This is due to the peculiar shape of the coils, which can be easily flat printed and then wrapped without difficulty around a cylindrical tube, or even the picture tube itself.

The self-capacity of the coils is very small, and this is highly important. The use of a sheet plastic insulating support, such as vinylite or teflon, ensures easy and cheap manufacture and guarantees sufficient insulation.

The total bulk of the deflecting yoke becomes very small indeed, and in no way comparable to the conventional unit. This, joined with electrostatic focus picture tubes, should result in a big saving of useful space around the neck of the tube.

Voltage Doubling

(*Continued from page 81*)

resistance of what amounts to the 0.41 volt meter are shown in the extreme right-hand column of Table 1. The values shown are those found by the voltage-doubling method which we have seen is not precise for rectifier-type instruments. At any given point, double the resistance required to be added to the decade minus the total resistance in the decade should, therefore, give the resistance of the rectifier-meter combination. Apparently nothing precise can be accomplished by determining the resistance of the rectifier-meter combination only.

Determining Resistance

It would be possible to accurately determine the resistance of a rectifier-type instrument by means of an ac microammeter which would accurately indicate actual rms values and which was provided with a graph showing terminal voltage drop at all scale positions. Suppose that by such means we had determined the resistance of our 0.41 volt meter to be the 1,510 ohms as estimated in the above tabulation. Such a determination would be useless, because it would imply that multiplier resistance would be required on the basis of 3,683 ohms per volt, or that 1,510 ohms would need to be added to make a 0.82 volt meter.

As a more practical example, take the military specification for VU meters from JAN-I-6. Here it is specified that the internal resistance of the instrument must be 3,900 ohms plus or minus 5% at the zero VU scale mark. An external resistor of 3,600 ohms, plus or minus 0.5% is used to make the zero VU mark represent 1.228 volts. In actual VU meters, the terminal voltage drop approximates 0.6 volt and from the above tabulation, it is clear that the error of the voltage-doubling method at this voltage level could approximate 5%. Also, as the error increases as the current level is decreased, and since 3,900 ohms at 0.6 volt corresponds to something under 160 μa, it becomes quite clear why it is most difficult to make an instrument, which the voltage-doubling method will pass as between 3,705 and 4,095 ohms, and which will still indicate zero VU with 1.228 volts applied through a 3,600 ohm external resistor.

It is the writer's considered opinion that in the light of the foregoing findings, the Military would be wise to set up a more realistic specification for rectifier-type instruments

wherein all reference to resistance and/or the voltage-doubling method would be omitted.

It should be noted with reference to Fig. 2 that the shapes of curves A and C were plotted in the range of 0 to 2% of the full current rating of the rectifier and in the current range most usually employed in current rectifier-type instruments. If the rectifier is operated at a higher current output, both A and C will tend toward the sine of curve B, but even with operation at full current load, A and C cannot completely conform to curve B.

Printed Circuit Artwork

(*Continued from page 97*)

the drafting machine. Squareness, or rather the lack of same, can cause severe problems in preparing multiple negatives. Don't count on your drafting machine being square. Check it before each job, and again after each job, and even during the work. Keep it square. Better yet, get a large triangle, and stick to a Jacobs rule for your work. Drafting machines are very risky.

The use of graph paper is another excellent way of assuring squareness and accuracy, if you know its shortcomings. Graph paper ruled in decimal and in fraction form is available in sheets and in rolls. If printed with a faint blue line it can be drawn on directly, then inked and used as finished art work. Here you must be careful, however. Despite the claims of extreme accuracy made by its suppliers, we have found graph paper to be off in dimension quite a bit, and to vary from sheet to sheet. Check your paper before you use it, and see if it is accurate enough.

Artwork Size

Just how big should art work be, and just how many times larger than finished result should it be? Here we can settle things by saying, the larger the scale the better, but never allow a piece of art work to exceed 20x30 in.; never draw it larger than five times actual size; and never ask that it be increased in size by more than 2:1. Your size limitations are controlled by the type of copy holders supplied with process cameras, and the scaling abilities of the camera itself. The most popular camera now in use has the limitations set forth above. As long as you stay within the limits set above, keep your copy as large as possible, since, as it is scaled down, the inevitable inaccuracies of your drawing shrink right along with the scaling down of

Printed Circuit Artwork

(*Continued from page* 143)

the layout. Too often we hear draftsmen tell us all about their abilities to draw to plus or minus 0.010, and all too often we find it running closer to 1/32 in. by the time it is inked. This does not make for good relations between design engineers and printed circuit producers.

Many printed circuit companies have different ideas as to just how trim lines should be put on drawings. There is only one way to keep them all happy; let them put them on themselves. This is done readily by drawing your trim line with a sharp blue pencil, lightly enough not to destroy the paper's surface, and heavy enough to be seen. Your supplier can then put the actual trim lines, which will print, as he sees best. Here is a good place for that one accurate dimension; take the longest side of the trim lines, and put the dimension here. Keep the dimension in blue pencil too, and you will save the darkroom a retouching job.

Corrections

Many a piece of otherwise perfect copy suffers from careless correction of errors. To correct an error, it is best to paint it out with Chinese white opaque water color, of white poster paint. Whatever you use, it must be absolutely opaque. (It is best to get special photographic opaque white.) If you wish, you may paste in a new area, but you must also paint the edges of the pasted-in piece with opaque white, or lines will appear in the finished negative. Do not use translucent paper as a paste-in piece, and expect a good job. The powerful lights used in photographing the copy burn right through the paper, and it might as well not have been put there at all. If slip you must, and we all do, do a good opaque-ing job and you'll be glad you did, as will your supplier.

Art Work Final Form

We have made circuits from everything—from original inked art work to faded blue prints. Naturally the worse the copy supplied, the more retouching necessary, and the poorer the finished piece. Even photostats, unless they are of the so-called "reproduction" type, do not give the same results as a piece of original art-work. Your circuit supplier, or his photographer can do a lot better job if you give him original art.

Abrasive Process

(*Continued from page 99*)

tions to which the process lends itself involve the cutting and abrading of hard, brittle substances. The wide latitude of control that can be maintained makes the process favorable to a wide variety of jobs, which range from "pin-point" deburring or cutting glass where relatively small amounts of material are to be removed.

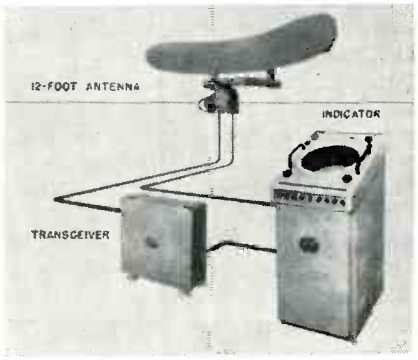
For instance, one manufacturer was faced with the problem of removing small burrs on the inside of 0.035-in. diameter stainless steel tubing. The burrs had previously been tediously removed by hand filing. By inserting the tubing over the end of the nozzle and sending the abrasive stream through the tube, the burrs were removed in about five seconds per tube.

In another case, the problem was to etch a dial facing on hard, polished plastic. The job was quickly and easily accomplished by directing the abrasive stream over a template placed over the plastic facing.

Soft Materials Immune

An interesting fact about the abrasive cutting stream is that it has practically no effect on soft materials. Thus, while it will readily drill a hole in hard, tempered glass, it will not have the slightest effect on skin tissue. This is a highly desirable safety feature because it will not cause injury should a worker accidentally get his hand in the way of the blast. Likewise, it is especially advantageous on certain jobs where a hard material is coated on a soft base.

NEW MARINE RADAR



New Mark 3 Marine Radar developed by Sperry Gyroscope Co., Great Neck, N.Y., for merchant ships and work boats is packaged into 3 compact units: a 12-foot scanner, a master indicator console containing 16 in. picture screen with new control circuits, and a transceiver unit for detecting nearby and distant objects, ranging from 20 yds. to 40 mi. Power is transmitted in 65 kw bursts. Pulse repetition is 3000 pps for 0.1 μsec pulses, 75 pps for 0.4 μsec pulses. Operating frequency is 9375 MC.

Soldering Techniques

(*Continued from page 75*)

tin plating seems to be the most apparent device with repeated accent on factors of corrosion resistance, longer shelf life and ultimately facile dip soldering operations. The fly in this ointment has been the complaint that residual acids in the plating baths have a tendency to contaminate circuit surfaces and resist flux action. Once again we are confronted with the problem of dirtied circuit patterns!

Longest shelf life seems to be had by a reversion to the old technique of tinning or solder coating conductor surfaces. The pre-tinned conductor is apparently well worth the extra solder dipping operation in terms of excellent shelf life as well as excellent component solderability. This should not be surprising when it is considered that a tinned conductor represents a partial step in the desired metal solvent action inherent to a well soldered joint while electroplating is simply the physical adherence of one metal to another. In a sense then, a tinned conductor can be represented as being one jump ahead of the electro-tin plated conductor. The foregoing should be qualified by saying that electro-tin plating is more widespread because its thickness, or build up on the circuit can be much more accurately controlled than pre-tinning which is accomplished by means of a solder bath dip.

Solder Fluxes

Assuming a well prepared printed panel we feel it necessary to lend only cursory consideration to fluxes. It is generally known that several very fine fluxes are available which are specifically adapted to printed circuitry. Needless to say these fluxes are for the most part Rosin or Resin type which are non-corrosive, electrically non-conductive and generally fungus-resistant. Typical characteristics of these available fluxes are readily volatile solvents, and desirable surface tension effect on molten solder. To reduce the tendency of such fluxes to thicken, because of solvent loss, it is always good practise to keep flux baths covered when not in use and to have available proper flux thinners.

A discussion of proper dip soldering temperatures can only be approached by giving careful attention to that basic article, the dip soldering pot. Aside from initial consideration to the proper sizes and

shapes for accommodation of the circuit panels, a good solder pot should offer these fundamental services:

(1) It should have sufficient capacity to produce solder temperatures up to 600 ° F.
(2) It must provide adequate thermal reservoir to maintain elevated temperatures under severest conditions of production dipping and resultant heat losses.
(3) It should be thermostatically controlled with a variation not exceeding ±10° F.
(4) The heat should be evenly distributed over the entire crucible. Localized "hot spots" can readily damage some printed circuit base materials.

Cast iron makes for a good rugged crucible. Also, the amalgamation of cast iron with molten solder is practically non-existent and there is no fear of solder contamination from this source. There are solder pots now available, constructed with crucible jackets containing special heating mediums which are highly stable thermally, non-explosive, vaporless and odorless. In these models, the heat source is immersed in the medium and results in terms of steady, even heat distribution are far superior to those obtained with contact or embedded type heating elements.

Solder Alloys

It has been found that solder alloys close to the eutectic composition exhibit most effective results in alloy formation and successful penetration of the intricate nooks and crevices of the component studded circuit boards. Widespread use of eutectic solder itself (63/37) is noted particularly with copper clad circuitry. This permits effective operation at temperatures approximating 450° F. although it seems evident that best results are obtained in the range of 500 to 575° F. Too often the important difference between solder melting points and their effective working temperatures is not considered. The optimum alloying or solvent action of solder cannot be accomplished without ample heat; the fact that a solder has melted does not mean that it is hot enough to bring the joints to be soldered to adequate temperature for good alloying. This gap between melting or liquid temperatures, and working (alloying) temperatures is more accentuated when departures are made from the eutectic, and even more when small amounts of silver are added to the alloy for dip soldering

Soldering Techniques

(Continued from page 147)

of silver-plated or silver-fired ceramic surfaces. In these cases, the plastic range of the solder (a condition just short of complete liquefaction) is increased. The more obvious manifestation of insufficient heat in the solder bath is high surface tension, and on the circuit boards the formation of excess solder in drip-like "stalactites" or "bridges" crossing insulated parts. The actual physical contour of a well soldered connection will be quite apparent, smooth, slightly rounded by surface tension in the bath but unmarred by excess driplets and blobs of solder. Only good flux action and an ample supply of evenly distributed heat can produce the desirable results.

Solder Facts

Tin does not "boil out" of a solder pot nor does it rise to the surface as in an oil-water mixture. This is a common misunderstanding of the properties of solder, the fact being that when solder is in a completely liquid state its ratio of tin-to-lead cannot be altered. Accordingly it is also a mistake to believe that one must periodically "prime" the pot with pure tin to make up for these fictional losses. While the solder bath is cooling at the end of a working day, there can occur "eutectic segregation" wherein lead rich crystals are first to precipitate leaving a tin rich alloy at the top which will be used first when the solder is remelted unless the completely molten solder is stirred before use. Further, a solder bath will always tend to become sluggish after the imposition of a long run work load due to the natural alloying action of solder itself. With metals such as brass and copper, contamination will eventually take place in the form of zinc or copper particles created by the dissolving of brass and copper in solder. When a solder bath becomes contaminated in this fashion, the most economical alternative is to replace the bath with fresh solder rather than to attempt priming with tin or pure solder. It might be well to add that dipping frames should be nickel plated steel since solder will not wet nickel.

Varying degrees of success have been reported with the application of palm oil or powdered charcoal to solder baths for the prevention of surface oxidation. However palm oil cannot be used at much above 450°

F. while with charcoal there is the ever present possibility of contaminating the circuit with a current carrier unless most stringent cleaning precautions are taken. The best middle of the road policy appears to be an occasional skimming of the pot with a flat piece of steel, porcelain, or even cardboard.

Although several of the larger companies have developed semi-automatic dipping procedures, very worthwhile production results are possible with the standard three bath routine (flux bath—solder dip—rinse). For instance, one manufacturer reported a production rate of approximately 100, seven square inch pieces per hour using the hand-dip three bath process. Even average results, however, cannot be expected without strict adherence to the few simple rules for good soldering.

Silicon Transistors

(*Continued from page 78*)

precipitated in the gold wire. It is a near miracle that the parent silicon crystal was not cracked in this case.

Fig. 10 shows a case where the wire was removed before cooling and this unfavorable cooling-induced-nucleation of the silicon was eliminated. This is a nearly perfect example of the effect of crystal forces on fusions, and points the way to almost ideal transistor junction geometries.

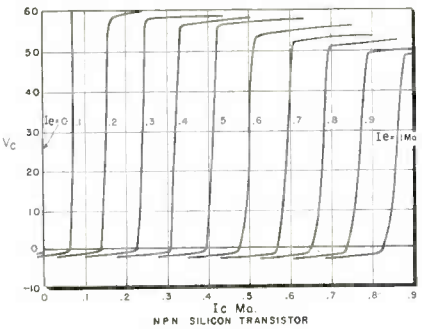


Fig. 12: Characteristic curves of fairly good silicon transistor with alpha 0.9

Fig. 11 is a section through a gold-silicon transistor with an alpha of about 0.6 at 5 volts and 1 ma. The diode characteristics of gold-silicon transistors are quite remarkable, being still good as high as 200 or more volts. The base resistances are about 300 ohms; the dynamic collector impedance of present units show a considerable dependence on emitter current, but in general are about 1 megohm, the emitter resistances run from *10* to *60* ohms, at one mil emitter current.

Improving the alpha still remains

Silicon Transistors

(*Continued from page* 149)

as a major problem. At present, few units are being made with alphas as high as 0.9. Since thermal lifetime degradation alone is not the reason for alpha problems at these low fusion temperatures, a great deal of effort is being expended at the present time in research aimed at solving this vexing problem.

Fig. 12 shows the characteristic curves of a fairly good silicon fusion transistor which has an alpha of about 0.9. Note the effect of emitter current on the collector voltage breakdown point.

Fusion Properties

Before doing any actual transistor fabrication work, a great deal of time was spent in investigating the fusion properties of more than 80 different alloys. The usefulness of any alloy is dependent upon many things such as: Does it wet the surface easily? Does it have the feature of being soft enough or having a coefficient of expansion close enough to silicon, so that it does not crack the silicon in cooling down? Will it fuse at low enough temperature so that thermally induced lifetime degradation is not too serious? Can the junctions formed be etched properly in presence of the alloy, and of course are the electrical properties of these junctions satisfactory?

A great deal of responsibility for the success of any transistor remains in the etching step, where the surface is cleaned to remove shorting paths and left in such a condition as to discourage recombination of the emitted electrons. This last point still has not been solved. The surface recombination velocity in some experimental units was of the order of 5000 cm/sec., as calculated from results obtained from other measurements with the micro optical light probe described earlier. This means that entirely too large a fraction of the emitted carriers die on the surfaces and never reach the collector.

In conclusion, we are convinced that none of the problems we have yet to solve are problems that cannot be solved by careful study, and feel confident that we will gradually overcome them within the relatively near future. The full impact of silicon transistors on the electronics field will not be seen for several years. It is to the advantage of all to treat common scientific problems as joint industry problems.

Printed I-F Amplifier

(*Continued from page 89*)

extremes of temperature—from —55° C to 80° C. It has withstood 10 G's of vibration at the lower frequencies—to 60 cpm—and suffered no damage at much higher frequencies. The base material was found to be sufficiently rigid and virtually impervious to moisture and fungus.

The gain of the prototype amplifier measures more than 115 db—i-f input to i-f output—with the required bandwidth and gain control. As a result of subminiaturization, the outside dimensions of the case are 7 in. long by 3⅜ in. wide by ⅞ in. deep.

Development Time

Because of its relative simplicity, the amplifier required less than the usual amount of time for development and testing. The black tape, used for delineation of the circuit, can be applied in a fraction of the time required for inking. Removal of the tape, for alteration or correction, is also less difficult than changing an inked drawing.

The etched circuit technique has established a foundation for modification and further i-f development

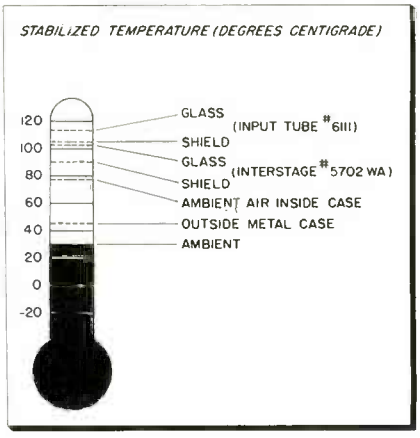


Fig. 4: Comparison of operating temperatures of various components in i-f amplifier

work. By adding to, or subtracting from, the length of the basic etched board, new amplifiers of different gains and bandwidths can be constructed—with little alteration of the tuning scheme. Thus i-f development time may be shortened considerably.

The amplifier is, moreover, easy to construct and maintain. Its components are commercially available and so placed that they can be quickly installed or replaced. The economic value of such a feature is quite obvious.

Glow Transfer Tubes

(*Continued from page 86*)

set by the other two methods previously described, are shown in Figs. 7 and 8.

Fig. 7 shows a switch tube, which cuts off when a signal appears, allowing the reset line to drift up. The switch tube must conduct sufficiently to keep the reset line at less than 20V for satisfactory operation.

For forced reset, the circuit of Fig. 8 is used. This is essentially the same circuit as that of Fig. 7, except that now the switch tube is used to switch +200V to the reset line.

Counter Tubes in Cascade

If it is required to count to numbers greater than the capacity of any one counter tube, a number of tubes can be placed in cascade.

Suppose we place three ten count tubes in cascade. Then the capacity of the system will be 1000 counts. Now let us assume we wish to reset the system after 576 counts. This can

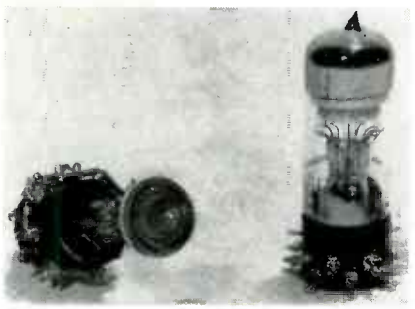


Fig. 10: Multi-element glow transfer tube

be done by the use of a three input "and" gate. The three inputs will be K_5 from tube 3, K_7 from tube 2, and K_6 from tube 1. There will be an output from this "and" gate only when the number 576 is reached. This arrangement is shown in Fig. 9. The output of this "and" gate is then fed to the circuits described previously. By switching the gate to various cathodes, we can again preset the system to count to any desired number.

A photo of a glow transfer tube made by Ericsson Valve Co., England, is shown in Fig. 10.

New Transformer Capsule

Aircraft Transformer Corp., West and Willow Sts., Long Branch, N. J., announces the manufacture of transformers by a patented process under the trade name, "Form-Flex." Sealed in new neoprene capsule and conventional can, the unit saves weight, space, and cost, yet meets the performance requirements of MIL-T-27, Grade 1 specifications.

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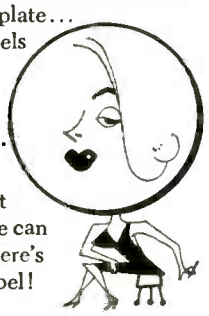

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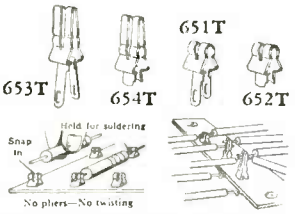

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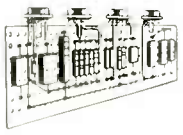

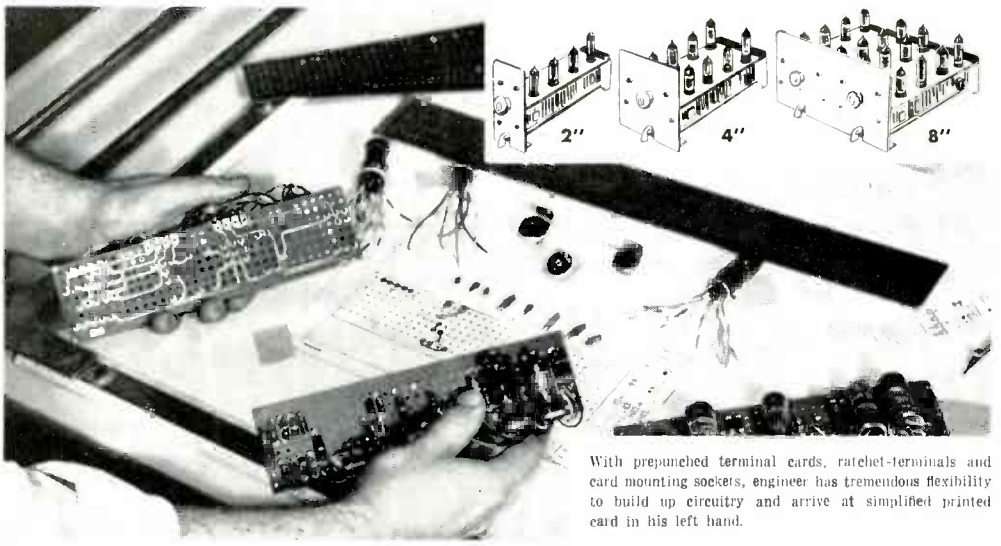

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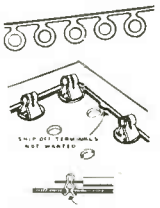

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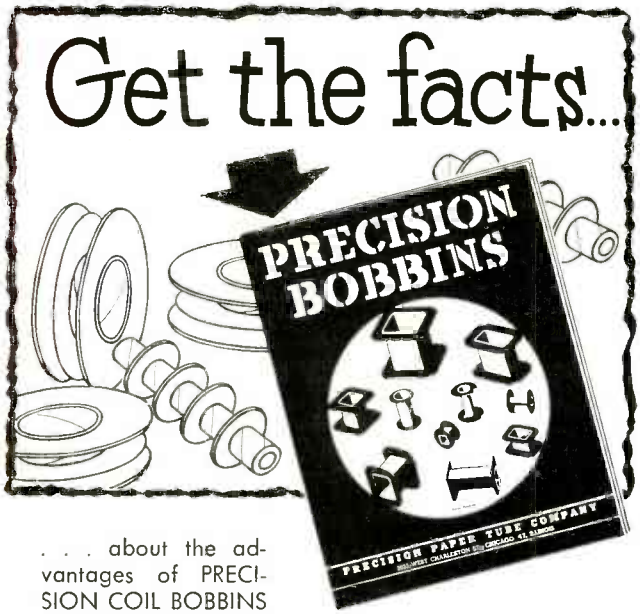

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1954 AUTHOR INDEX

Subharmonic Oscillator

(Continued from page 86)

Marrison in 1933, electronic engineers have apparently been almost entirely unaware of this signal-generating technique.

In this oscillator, the necessary synchronizing signal is obtained simply by coupling a quartz crystal to an ordinary blocking oscillator, by means of a third transformer winding. Alternatively, the crystal can be connected across either the grid or plate winding of the transformer, or connected directly between grid and plate. Coupling by means of a third transformer winding seems preferable, however, since it avoids d-c voltage on the crystal and permits grounding the rotor of a trimmer condenser placed across the crystal.

Division ratios as high as 10,000 to 1 have been obtained only with a few crystals. Such extreme ratios would probably seldom be of practical value; a small change in circuit constants might cause the fundamental frequency to change from 1/10,000 to 1/10,001 of the crystal frequency, for instance, and such a small change in frequency could easily go undetected with ordinary equipment. Division ratios of several hundred are readily obtained, however, and can be maintained with high stability if supply voltages are held reasonably constant. Crystal-controlled signals can thus easily be generated at frequencies much lower than those of generally available crystals. The wide range of possible division ratios means that a desired fundamental frequency can be obtained from any of a large number of crystal frequencies. Conversely, a single crystal can be used to give crystal-controlled output at any of a large number of fundamental frequencies. The upper limit of blocking-oscillator fundamental frequency is determined by the characteristics of the pulse transformer; this limit appears to be above 200 kilocycles with a typical transformer.

Gudeman Buys Dilectron

Gudeman Co., electronic components manufacturer, has purchased Dilectron, Inc., 2661 So. Myrtle St., Monrovia, Calif., manufacturer of ceramic capacitors. The Dilectron plant is Gudeman's 5th plant and will be known as the Dilectron Div. of Gudeman Co. The main factory is at 340 W. Huron St., Chicago 10, Ill., and the other 3 are in Chelsea, Mich., Los Angeles, and Sunnyvale, Calif.

Computer Conference

(*Continued from page 68*)

FRIDAY, DECEMBER 10

"Numerical Solution of Differential Equations," Herbert M. Gurk, Morris Rubinoff, Moore School of Electrical Engrg. Univ. of Pa.

"Applications of Automatic Coding to Small Calculators," Leroy D. Krider, Applied Mathematics Div., U.S. Naval Ordnance Lab.

"Automation of Information Retrieval," J. W. Perry, Battelle Memorial Institute.

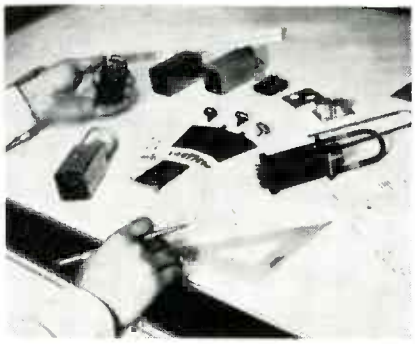
"Message Storage and Processing with a Magnetic Drum," A. P. Hendrickson, J. L. Hill, G. I. Williams, Engrg. Research Associates Div., Remington Rand, Inc.

"Analysis of Business Application Problems on IBM 650 Magnetic Drum Data Processing Machine," George W. Petrie III, International Business Machines Corp.

"Small Digital Computers and Automatic Optical Design," N. A. Finkelstein, Bausch & Lomb Optical Co.

"Computation of the Performance of Decision Element Circuits by Means of the IBM CPC." B. F. Cheydleur, Minnesota Electronics Corp., L. P. Gieseler, H. L. Stevens, U.S. Naval Ordnance Lab.

TERMINAL CARD MOUNT



Closeup view of new terminal card mounting system which can be moved easily from the layout stage through breadboard, pilot runs and production. Pre-punched terminal cards, card mounting sockets, and ratchet terminals comprise the elements. They mount up into compact vertical planes. As volume grows mounting boards become printed circuits.

Terminal card mounting system being used to mount circuitry for plug-in chassis and larger plug-in units. Same basic elements as shown above are used. Alden Products Co., 117 N. Main St., Brockton, Mass., is supplier.

New RS Electronics Plant

RS Electronics Corp. has opened its new lab. and factory on Portage Ave. in Palo Alto, Calif., to manufacture radar scanners and engage in the fields of electronic miniaturization, product design, electronic automatic production, and etched and printed circuitry.

INDUSTRY NEWS

(*Continued from page 62*)

Lieutenant Colonel Herbert H. French, U. S. Air Force, was recently elected Director of the Electronics Productions Resources Agency, Department of Defense.

David A. Nadel, former sales engineer, has been promoted to the position of sales manager in Loral Electronics Corp., 794 E. 140 St., New York, N.Y. Priorly, Mr. Nadel was associated with the American Machine & Foundry, Inc., electronic division.

D. A. Nadel

E. A. Freed

Edwin A. Freed has been made general sales manager of General Instrument Corp. Formerly operational head and sales manager of the Elizabeth, N.J. headquarters division, Mr. Freed will now be in charge of all products made by General Instrument and its manufacturing subsidiaries, including its F. W. Sickles and Elizabeth divisions. His office will be in Elizabeth.

Jack Powers has been appointed sales manager of Edwin I. Guthman & Co., Inc., 15 S. Throop St., Chicago, Ill. where he will promote product sales, manage representation, service customers, and be responsible for all sales. Mr. Powers was formerly a representative in the Chicago area.

Donald W. Jackson was recently appointed national merchandise manager for the Dage Television Div., Thompson Products, Inc., Cleveland Rd., Cleveland, O. His work will include the appointment of distributors, and the development of merchandising, promotion, and direct mail programs.

Irving G. Rosenberg, vice president of Allen B. DuMont Laboratories, Clifton, N. J., has been assigned the executive responsibility to direct the Communication Products Division, 1500 Main Ave., Clifton. He will continue to direct the government manufacturing and cathode-ray tube divisions.

Frank T. Gain has been appointed sales mgr. of Airdesign, Inc., Upper Darby, Pa. He will set up nat'l representation for the company's industrial and military products.

TELE-TECH ADVERTISERS — DECEMBER, 1954

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

HF Conference

(*Continued from page 52*)

sponsored by IRE, AIEE, URSI and the Natl. Bur. of Standards. The program of technical papers follows:

Monday—Measurement of Transmission and Reception

Presiding: B. Parzen, Olympic Radio & Television Co., Long Island City, N. Y.

"**Measurements and Components for Rectangular Multimode Waveguides**" by D. Angelakos, Electronic Research Lab., Univ. of Cal., Berkeley, Cal.

"**A Comparison Method for Tuning Wideband TR Tubes**" by H. Rickert, Wheeler Labs., Inc., Great Neck, N.Y.

"**Radio Interference Measurement Techniques**" by L. Thomas, Bur. of Ships, Navy Dept., Washington, D.C.

"**Pattern Measurements of Large Fixed Antennas**" by J. Shanklin, Collins Radio Co., Cedar Rapids, Iowa.

"**Accurate Radar Attenuation Measurements Achieved by In-Flight Calibration**" by F. Janza & R. West, Sandia Corp., Sandia Base, Albuquerque, N.M.

"**Use of Distribution Curves in Evaluating Microwave Path Clearance,**" by B. Wheeler & H. Mathwich, RCA Electronic Prods. Div., Camden, N.J.

Tuesday—Measurement of Power and Attenuation

Presiding: E. W. Houghton, Bell Tel. Labs., Murray Hill, N.J.

"**6 KMC Sweep Oscillator,**" D. Alsberg, Bell Tel. Labs., Inc., Murray Hill, N.J.

"**Data on Temperature Dependence of X-Band Fluorescent Lamp Noise Sources**" by W. Mumford & R. Schafersman, Bell Tel. Labs., Inc., Whippany, N.J.

"**Broadband UHF and VHF Noise Generators,**" W. Spencer & P. Strum, Airborne Instruments Lab., Mineola, N.Y.

"**A Noise Meter Having Large Dynamic Range,**" P. Strum, Airborne Instruments Lab., Mineola, N.Y.

"**Precise Insertion Loss Measurements Using Imperfect Square Law Detectors and Accuracy Limitations Due to Noise,**" B. Weinschel, Weinschel Engrg. Co., Inc., Kensington, Md.

"**Microwave Peak Power Measurement Techniques.**" R. Henning, Sperry Gyroscope Co., Great Neck, N.Y.

Wednesday—Measurement of Impedance

Presiding: A. A. Oliner, Polytechnic Inst. of Brooklyn, Brooklyn, N.Y.

"**Application of UHF Impedance Measuring Techniques in Biophysics,**" by H. Schwan Moore School of Electrical Engrg., Univ. of Pa., Philadelphia, Pa.

"**Representation and Measurement of a Dissipative Four-Pole by Means of a Modified Wheeler Network,**" by H. Altschuler, Microwave Research Inst., Polytechnic Inst. of Brooklyn, Brooklyn, N.Y.

"**The Use of Concentric-Line Transformers in UHF Measurements,**" by W. Harris & J. Thompson, Radio Corp. of Amer., Harrison, N.J.

"**Figure of Merit of Probes as Standing Wave Detectors,**" by S. Rubin, Polytechnic Research & Devel. Corp., Brooklyn, N.Y. and M. Wind, Microwave Research Inst., Polytechnic Inst. of Brooklyn, Brooklyn, N.Y.

"**Characteristics of Microwave Comparators,**" by E. Matthews, Sperry Gyroscope Co., Great Neck, N.Y.

"**A Comparison Method for Measuring Cavity Q,**" by E. Mullen & P. Pan, General Electric Co., Syracuse, N.Y.

Measurement of Frequency and Time

Presiding: B. M. Oliver, Hewlett-Packard Co., Palo Alto, Cal.

"**A Portable Frequency Standard for Navigation,**" by P. Antonucci, Rome Air Devel. Center, Rome, N.Y., & J. Israel, E. Mechling, & F. Merrill, Bell Tel. Labs., Murray Hill, N.J.

"**Locked Oscillators in Frequency Standards and Frequency Measurements,**" by J. Clapp, General Radio Co., Cambridge, Mass.

"**Measurement of the R-F Frequency of R-F Pulses,**" by A. Bagley & D. Hartke, Hewlett Packard Co., Palo Alto, Cal.

"**An Instrument for Precision Range Measurements,**" by D. Beck, Hazeltine Electronics Corp., Little Neck, N.Y.

"**6 KMC Phase Measurement System for Traveling Wave Tubes,**" by C. Angustine & A. Slocum, Bell Tel. Labs., Murray Hill, N.J.

"**A Precision X-band Phase Shifter,**" by E. Barnett, Hewlett-Packard Co., Palo Alto, Cal.

Bomac

SILICON DIODES

Bomac Silicon Diodes are manufactured to exceptionally high standards to assure electrical uniformity and mechanical stability. New design considerations and improved manufacturing techniques have resulted in X-and S-band crystals of increased burnout resistance and higher humidity resistance.

- TOP PERFORMANCE
- UNIFORMITY
- STABILITY

Band	Type	Freq. (MC)	Max. Conversion Loss db	Noise Ratio (Times)	Max. VSWR	IF Impedance (Ohms)
S	1N21B	3060	6.5	2.0	—	—
S	1N21BR	3060	6.5	2.0	—	—
S	1N21C	3060	5.5	1.5	—	—
S	1N21CR	3060	5.5	1.5	—	—
X	1N23B	9375	6.5	2.7	—	—
X	1N23BR	9375	6.5	2.7	—	—
X	1N23C	9375	6.0	2.0	1.50	325-475
X	1N23CR	9375	6.0	2.0	1.50	325-475
X	1N149	9375	5.5	1.5	1.25	325-475
X	1N23D	9375	5.0	1.7	1.25	350-450
X	1N23DR	9375	5.0	1.7	1.25	350-450

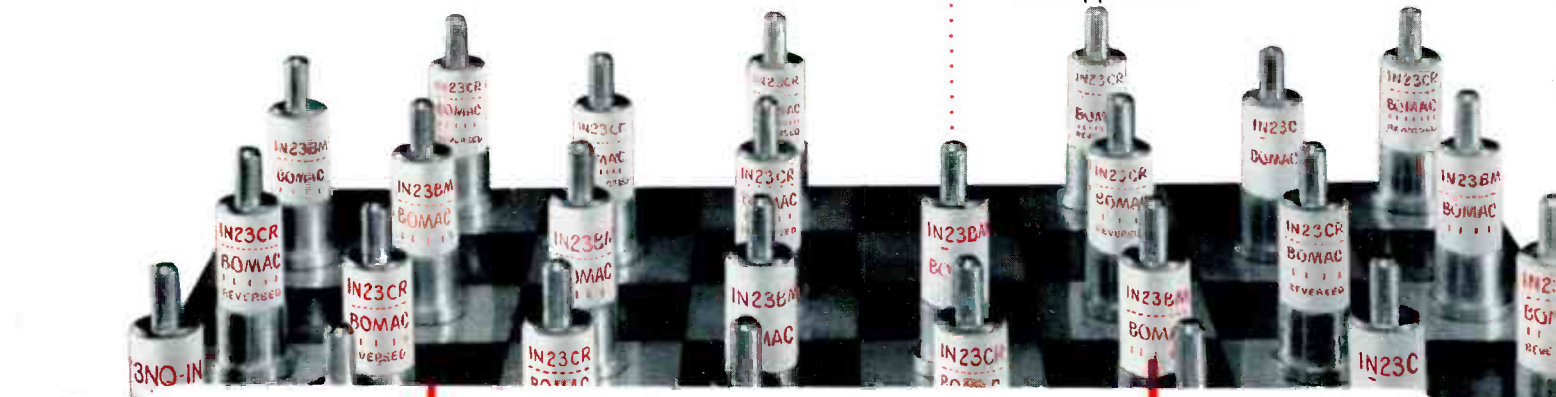
The above diodes may be supplied in pairs wherever their characteristics are matched as follows:

Conversion Loss ..... ± 10%
IF Impedance ..... ± 15 ohms
Rectified Current ..... ± 10%
RF Impedance (VSWR) ..... Such that unbalance ≦ 10% of available power

UNIQUE PACKAGE PROTECTION

For complete protection during shipment and storage Bomac has designed a reusable RF Protective Package* which conforms with MIL-E1B specification. Diodes stored in this package are completely protected no matter how many times they are handled after the original seal is broken.

*Pat. applied for



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COLOR TV COMES OF AGE

The RCA 21-INCH COLOR PICTURE TUBE, *the tube in your future,* is here. Intensive RCA research brings you full-sized pictures of excellent clarity and brightness . . . makes production-line color TV a reality. Outstanding features of the new RCA-21AXP22 are:

21" round tube with aluminized phosphor dot screen gives largest picture in color TV, a full 250 square inches of brilliant color.

Metal shell means lighter weight and greater mechanical strength.

Thermally-compensated, spherical shadow mask permits uniform expansion of mask for improved color registration and brighter pictures.

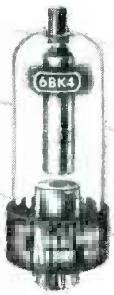
70° deflection angle—combined with a short electron gun having improved resolution—provides a short tube which permits reduced cabinet depth.

RCA-21AXP22

- **21-inch metal envelope**
- **electrostatic focus**
- **magnetic deflection**
- **magnetic convergence**

Three New RCA-Developed Receiving Tubes for Color TV

RCA-6BL4— Half-Wave Rectifier Tube (Damper Diode)



RCA-6BK4— Sharp-Cutoff Beam Triode (Shunt Voltage Regulator)

RCA-6CB5— Beam PowerTube (Horizontal-Deflection Amplifier)

RCA pioneered and developed compatible color television

RADIO CORPORATION of AMERICA

ELECTRON TUBES **HARRISON, N.J.**