May 26, 1961

electronics

Filling and calibrating an ultraviolet detector tube (below).
Inset shows tube's symmetrical electrode construction, p 52
Interstage design of Butterworth stagger-loaded amplifiers, p 60

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HERMETIC AUDIO AND POWER COMPONENTS...FROM STOCK

UTC stock hermetic units have been fully proved to MIL-T-27A, eliminating the costs and delays normally related to initial MIL-T-27A tests. These rugged, drawn case, units have safety factors far above MIL requirements, and are ideal for high reliability industrial applications. Listed below are a few of the hundred stock types available for every application. Industrial ratings in bold.

Typical Miniature Audios

RC-25 Case
61/64 x 1-13/32 x 1-9/16
1.5 oz.

Type No	Application	MIL Type	Pri. Imp. Ohms	Sec. Imp. Ohms	Unbal. DC in Pri. MA	Response 2 db (Cyc.)	Max. level dbm
H-1	Mike, pickup, line to grid	TF4RX10YY	50, 200 CT, 500 CT	50,000	0	50-10,000	+ 5
H-2	Mike to grid	TF4RX11YY	82	135,000	50	250-8,000	+18
H-5	Single plate to P.P. grids	TF4RX15YY	15,000	95,000 CT	0	50-10,000	+ 5
H-6	Single plate to P.P. grids, DC in Pri.	TF4RX15YY	15,000	95,000 split	4	200-10,000	+11
H-7	Single or P.P. plates to line	TF4RX13YY	20,000 CT	150/600	4	200-10,000	+21
H-8	Mixing and matching	TF4RX16YY	150/600	600 CT	0	50-10,000	+ 8
H-14	Transistor interstage	TF4RX13YY	10K/2.5K, Split	4K/1K split	4	100-10,000	+20
H-15	Transistor to line	TF4RX13YY	1,500 CT	500/125 split	8	100-10,000	+20

Type No.	Application	MIL Type	Pri. Imp. Ohms	Sec. Imp. Ohms	Unbal. DC in Pri. MA	Response ± 2 db (Cyc.)	Max. level dbm
H-20	Single plate to 2 grids, can also be used for P.P. plates	TF4RX15YY	15,000 split	80,000 split	0	30-20,000	+12
H-21	Single plate to P.P. grids, DC in Pri.	TF4RX15YY	15,000	80,000 split	8	100-20,000	+23
H-22	Single plate to multiple line	TF4RX13YY	15,000	50/200, 125/500	8	50-20,000	+23
H-23	P.P. plates to multiple line	TF4RX13YY	30,000 split	50/200, 125/500	8 BAL.	30-20,000	+19
H-24	Reactor	TF4RX20YY	450 Hys.-0 DC, 250 Hys.-5 Ma. DC, 6000 ohms 65 Hys.-10 Ma. DC, 1500 ohms				
H-25	Mixing or transistors to line	TF4RX17YY	500 CT	500/125 split	20	40-10,000	+30

Typical Compact Audios

RC-50 Case
1-5/8 x 1-5/8 x 2-5/16
8 oz.

Typical Subminiature Audios

SM Case
1/2 x 11/16 x 29/32
.8 oz.

Type No	Application	MIL Type	Pri. Imp. Ohms	Sec. Imp. Ohms	Unbal. DC in Pri. MA	Response ± 2 db (Cyc.)	Max. level dbm
H-31	Single plate to 1 grid, 3:1	TF4RX15YY	10,000	90,000	0	300-10,000	+13
H-32	Single plate to line	TF4RX13YY	10,000	200	3	300-10,000	+13
H-33	Single plate to low imp.	TF4RX13YY	30,000	50	1	300-10,000	+15
H-35	Reactor	TF4RX20YY	100 Henries-0 DC, 50 Henries-1 Ma. DC, 4,400 ohms.				
H-36	Transistor interstage	TF4RX15YY	25,000 (DCR800)	1,000 (DCR110)	.5	300-10,000	+10
H-39	Transistor interstage	TF4RX13YY	10,000 CT (DCR600)	2,000 CT	2	300-10,000	+15
H-40A	Transistor output	TF4RX17YY	500 CT (DCR26)	600 CT	10	300-10,000	+15

Type No.	HV Sec. CT	DC MA*	Military Rating Fil. Secs.	DC MA*	Industrial Rating Fil. Secs.	Case
H-80	450	120	6.3V,2A	**130**	**6.3V,2.5A.**	FA
H-81	500/550	65/55	6.3V,3A-5V,2A	**75/65**	**6.3V,3A.-5V,2A.**	HA
H-82	540/600	110/65	6.3V,4A.-5V,2A.	**180/100**	**6.3V,4A.-5V,2A.**	JB
H-84	700/750	170/110	6.3V,5A.-6.3V,1A.,5V-3A.	**210/150**	**6.3V,6A.-6.3V,1.5A.-5V,4A.**	KA
H-89	850/1050	320/280	6.3V,8A.-6.3V,4A.,5V-6A.	**400/320**	**6.3V,8A.-6.3V,4A.-3V,6A.**	OA

Typical Power Transformers

Pri: 115V 50/60 Cyc.
*Choke/Cond. inp.

Type No.	Sec. Volts	Amps.	Test Volts	Case	Type No.	Sec. Volts	Amps.	Test Volts	Case
H-121	2.5	10(12)	10 KV	JB	H-131	6.3 CT	2(2.5)	2500	FB
H-122	2.5	20(26)	10 KV	KB	H-132	6.3 CT 6.3 CT	6(7) 6(7)	2500	JA
H-125	5	10(12)	10 KV	KB	H-133	6.3 CT	7(8)	2500	HB
H-130	6.3 CT	.6(.75)	1500	AJ	H-134	6.3 CT	10(12)	2500	HA

Typical Filament Transformers

Pri: 105/115/210/220V
except H-130 (115) and
H-131 (115/220) 50/60 Cyc.

Typical Filter Reactors

Type No.	MIL Type	Ind. Hys. @	MA DC	Ind. Hys. @	MA DC	Ind. Hys. @	MA DC	Ind. Hys. @	MA DC	Res. Ohms	Max. DCV Ch. Input	Test V. RMS	Case
H-71	TF1RX04FB	20	40	18.5	50	15.5	60	10	70	350	500	2500	FB
H-73	TF1RX04HB	11	100	9.5	125	7.5	150	5.5	175	150	700	2500	HB
H-75	TF1RX04KB	11	200	10	230	8.5	250	6.5	**300**	90	700	2500	KB
H-77	TF1RX04MB	10	300	9	350	8	**390**	**6.5**	435	60	2000	5500	MB
H-79	TF1RX04YY	7	800	6.5	900	6	1000	5.5	1250	20	3000	9000	7x7x8

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May 26, 1961

electronics

A McGraw-Hill Publication *75 Cents*

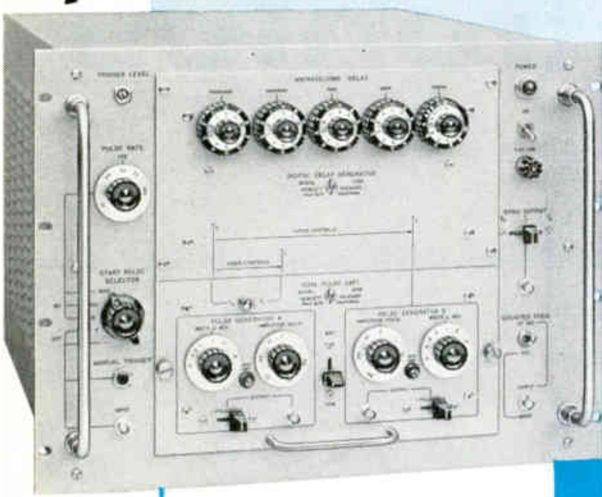
W. W. MacDONALD, Editor

BUSINESS

ENGINEERING

DEPARTMENTS

MEASURE TIME; 0.1 µsec ACCURACY!



-hp- 218AR Digital Delay Generator produces crystal controlled pulses accurately spaced in time. Pulses or time intervals are initiated by an internal rate generator or an external trigger. The instrument is thus both a digital delay generator and an extremely high accuracy laboratory pulse generator.

-hp- 219A

-hp- 219B

-hp- 219C

Time measurement and pulse simulation in radar, loran, Tacan, DME, oscilloscopes, computers, fast gates, pulse code systems—almost any kind of time measurement single- or double-pulse simulation is now yours quickly and accurately with -hp- 218AR Digital Delay Generator.

Built along strict military standards, -hp- 218AR uses a pulsed crystal oscillator synchronizable in *constant phase* with an initial trigger pulse (zero time) to position the two terminating pulses. Time is counted with a 1 megacycle preset counter, and two independent output pulses are available in any relationship.

PULSE GENERATOR PLUG-INS

For utmost versatility, output pulses are generated in various arrangements by three plug-in pulse generators. These include -hp- 219A, supplying two positive pulses, -hp- 219B providing two pulses, each positive or negative and variable in amplitude, -hp- 219C, providing a high power pulse, positive or negative, digitally controlled as to delay and duration, variable in amplitude.

Condensed Specifications

(Basic 218AR Generator; plug-ins essential)

Time Interval Range:	1 to 10,000 µsec	**Recovery Time:**	50 µsec or 10% of interval, whichever is greater
Accuracy:	± 0.1 µsec ± 0.001%	**Sync Output:**	50 v pos. pulse, 0.1 µsec rise time
Digital Adjustment:	1 µsec steps, full range	**1 MC Output:**	1 v pulses, 500 ohm impedance
Interpolation:	Variable 0 to 1 µsec	**Price:**	-hp- 218A, $2,000.00 -hp- 219A Dual Trigger Unit, $100.00 -hp- 219B Dual Pulse Unit, $450.00 -hp- 219C Digital Pulse Duration Unit, $350.00
Input Trigger:	Internal 10 cps to 10 KC; External 0 to 10 kc pulses, also sine wave		
Jitter:	0.02 µsec or less		

Data subject to change without notice. Prices f.o.b. factory

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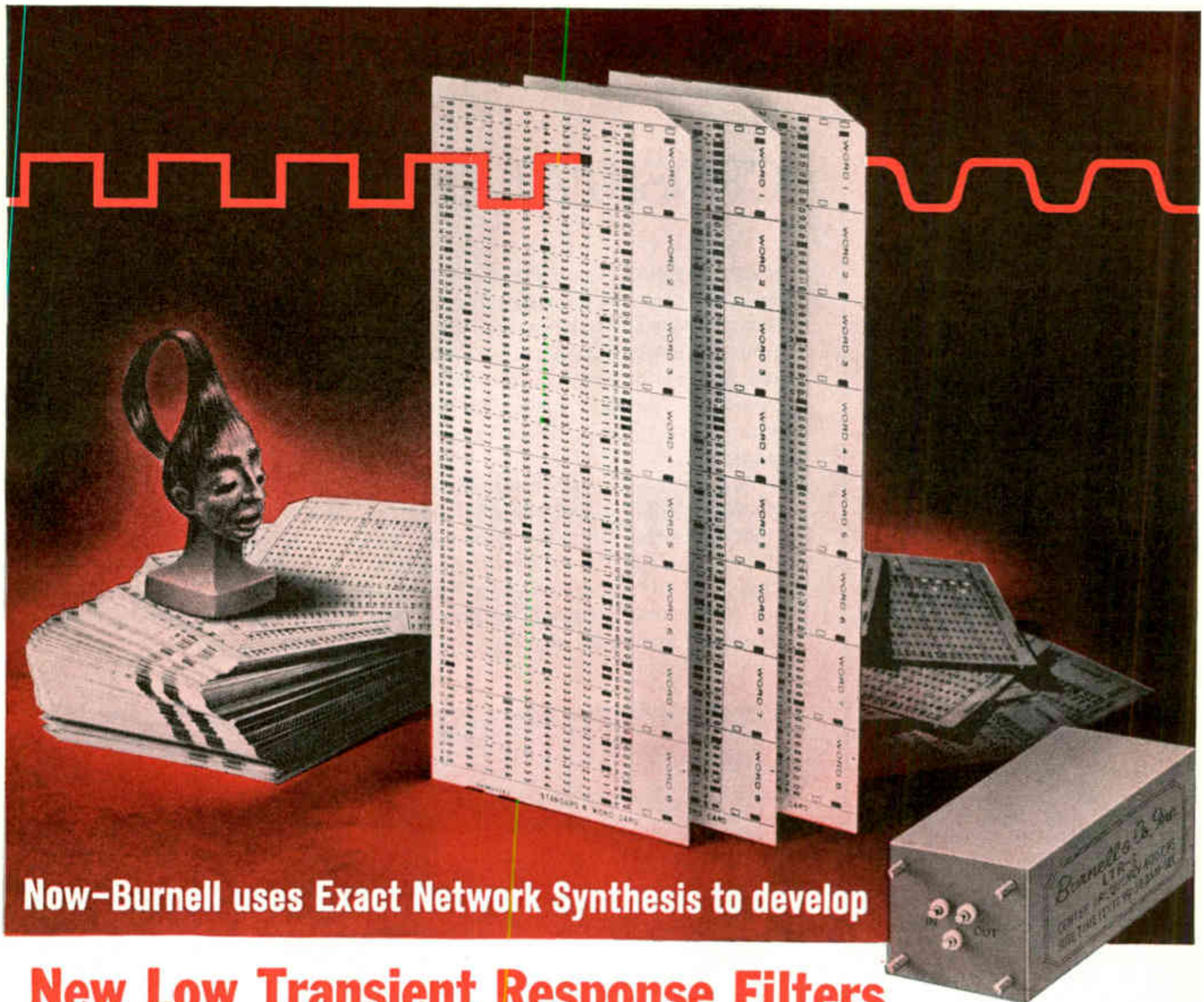


Now–Burnell uses Exact Network Synthesis to develop

New Low Transient Response Filters

New digital computer techniques for network synthesis have enabled Burnell & Co. to produce filters possessing the special time and steady state properties so essential to today's high precision, communication, data and guidance systems. An example of this achievement is the Burnell Type LTR-1 which overcomes problems formerly insoluble through the use of standard design procedure.

More than a linear phase band pass achievement, this new Burnell "low ringing" filter combines the center frequency, band width, rise time and attenuation characteristics that insure minimum phase distortion and low transient response. Hermetically secure, the LTR-1 easily shrugs off shock, vibration, acceleration and other hazards encountered in extreme environments.

TECHNICAL DATA

Center frequency: 400 cps

Pass band width: (3db) down +20% —16.5% of center frequency

Attenuation: 30 db at one-half and twice center frequency

Overshoot: ("low ringing") 1%

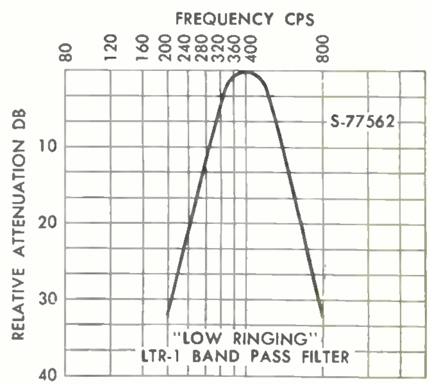
Rise time: (1% to 99%) 6.25 ms.

Meets MIL-F 18327A specifications.

If your circuit needs can not be met by the LTR class of filters or our stock of more than 15,000 specialized filter designs, Burnell engineers will, of course, manufacture to your specifications.

Write for Filter Bulletin.

With the aid of our new Guillemin Research Laboratory, we are now able to solve your network problems in an even wider range than ever before.



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CIRCLE 3 ON READER SERVICE CARD

electronics
May 26, 1961 Volume 34 Number 21

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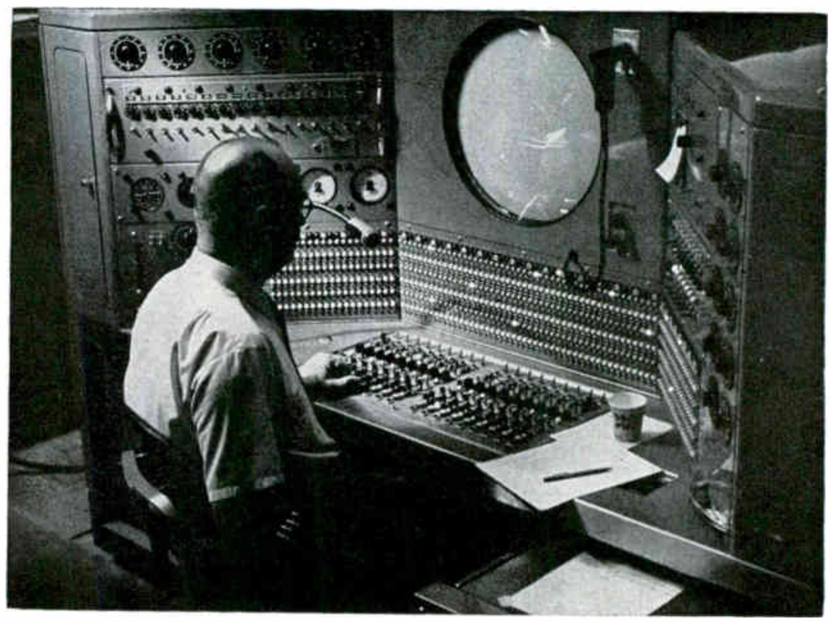
CROSSTALK

SOVIET INFORMATION. The Russians don't tell us much, but that doesn't mean we can't do some figuring on our own. During the past two years ELECTRONICS has put together important firsts—such as how the Russians guided Lunik (ELECTRONICS, p 22, Feb. 6, 1959 and p 26, Oct. 2, 1959), and the first artist's conception, including details, of the massive CH-10 rocket booster that made the Russian's spectacular space shots. The latter drawing and article were picked up by many newspapers and magazines.

This week we have a comprehensive article (p 24) on how the Russians photographed the far side of the moon. Much of the information came from the Atlas Obratnoy Storony Luny (Atlas of the Far Side of the Moon), published in Moscow and recently translated by the Aeronautical Chart and Information Center, USAF, St. Louis, Mo. The two diagrams are ELECTRONICS' concept of how it was done. The equipment's extreme simplicity surprised us.



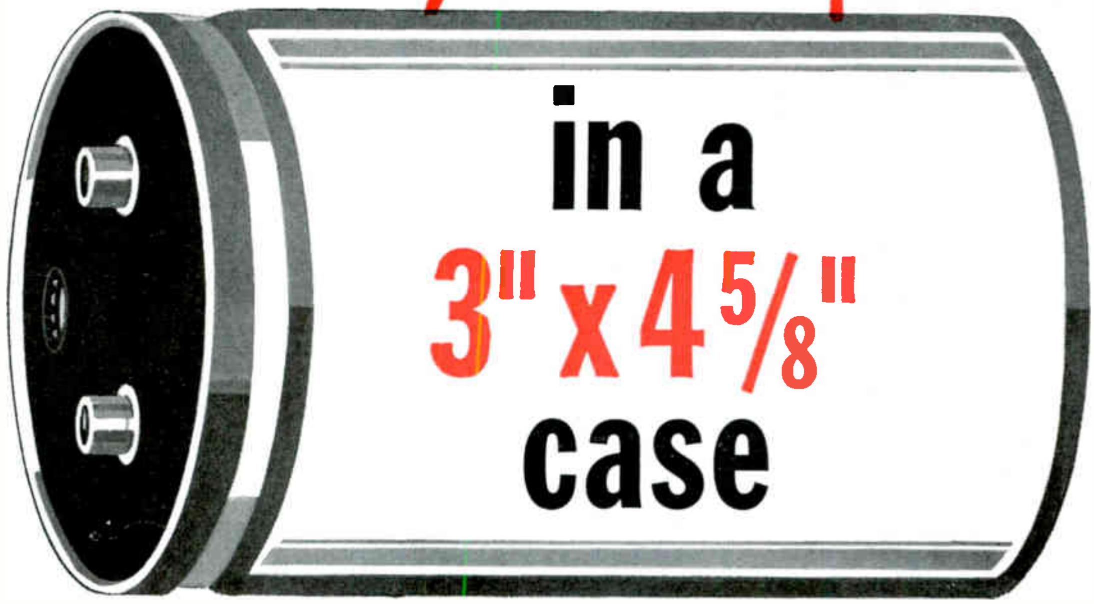
AIR-TRAFFIC CONTROL. Operator in photo above is shown at one of the monitors in a ground-based system for controlling high-density traffic at air terminals. System operation is described by R. Meuleman and S. D. Moxley, Jr. of Avco Corp. in their article beginning on p 47.

Coming In Our June 2 Issue

DEEP-OCEAN VELOCIMETER. One tool coming into increasing use in oceanography is the velocimeter (ELECTRONICS, p 53, July 29, 1960, and p 69, Sept. 9, 1960). In our next issue, Assistant Editor Dulberger explains the operation of this device and shows how it is being used to aid the design of sonar systems.

Other articles on undersea electronics that we have carried so far this year include: the Polaris computer (p 40, Jan. 6), sonar thumpers (p 56, Feb. 3) and sonar for guiding subs (p 18, March 24).

150,000 µF



*Powerlytic** Capacitors are packed with capacitance!

Designed specifically for applications requiring maximum capacitance in small physical size, Sprague Type 36D Aluminum Electrolytics find wide use in power supplies for digital computers, industrial controls, high-gain amplifiers, and allied equipment. Furnished in case sizes ranging from 1⅜" dia. x 2⅛" long to 3" dia. x 4⅝" long, Powerlytic Capacitors are available with capacitances which were previously impossible to obtain in the various case sizes.

Engineered for 65 C Operation

In Powerlytics, Sprague's many years of research, design, and production experience have produced a capacitor which allows the equipment designer maximum space economy for operating temperatures up to 65 C. This encompasses the great majority of applications in transistorized digital equipment and similar apparatus.

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Powerlytic Capacitors have not only low ESR and low leakage currents but offer extremely long shelf life as well. Furthermore, they have the ability to withstand unusually high ripple currents.

Superior Seal and Safety Vents

Type 36D Powerlytics use the most reliable seal that Sprague has developed for aluminum electrolytic capacitors. This consists of crimping a beaded aluminum can onto a rubber gasket recessed in a rigid molded cover. Pressure-type safety vents employing silicone rubber are used on all case covers.

Choice of Terminal and Insulating Tube Styles

Tapped terminal inserts, often preferred for strap or bus bar connections, are available as well as solder lug terminals for use with permanently wired connections. In addition to the standard bare case, Powerlytic Capacitors may also be obtained with a new clear skin-tight plastic tube which adds very little to the bare case dimensions. They are also available with a Kraftboard tube.

Broad Range of Standard Ratings

Sprague's standard line of Powerlytic Capacitors includes 183 ratings covering capacitance values from 45 to 150,000 µF, in voltages from 3 to 450 WVDC. Each rating is the maximum capacitance available for a given case size.

• • •

For complete technical data on Type 36D Powerlytic Capacitors, write for Engineering Bulletin 3431 to Technical Literature Section, Sprague Electric Company, 35 Marshall Street, North Adams, Massachusetts.

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COMMENT

Computers Today

I was delighted to read of IBM's interest in transformer logic as reported in your "Computers Today" special report (p 63, Apr. 28). I would like to take this opportunity to point out that the circuits of Fig. 21, 22 and 23 on p 83 of that issue are essentially identical in concept and detail to the illustrative diagrams accompanying patents 2,909,674, and 2,909,680, issued to Stanley Schneider and myself in 1959 and assigned to the Burroughs Corp. Applications for these patents were made in March 1957. They cover the general applications of diode-controlled pulse transformers to digital logic systems; the second patent covers the specific case of the implementation of a conditional steering gate for a complementing flip-flop with this logic technique.

One advantage of this kind of logic is its functional similarity to relay logic. A disadvantage is that fan-out from a particular transformer markedly affects the damping on that transformer and therefore its recovery time. In addition, the effect of distributed capacitances and inductances interacting with leakage and magnetizing inductances of the pulse transformers was difficult to calculate.

Several building-blocks and test subsystems operating between 250 Kc and 15 Mc were implemented with this diode-transformer logic in 1956.

Although other techniques have proved more satisfactory for general-purpose logic systems, the general principles involved have been useful in special applications.

Thank you for the opportunity to add a historical footnote to your special computer report.

J. KENNETH MOORE
CBS LABORATORIES
STAMFORD, CONN.

. . . I have been meaning to write and send you my compliments on such a comprehensive and detailed, yet lively and interesting, presentation. I am sure I cannot fully appreciate the monumental amount of effort that went into the preparation of a report on this scale, but I do appreciate the quality of the end result. You can be assured of our continuing good will and cooperation . . .

JOHN A. KESSLER
MIT LINCOLN LABORATORY
LEXINGTON, MASS.

Mercury Ground Station

Reference your article "Island Station Will Control Mercury Capsule," p 28, Apr. 14: the following comments are offered:

There are six, not five, command control stations in the project Mercury tracking and ground instrumentation range. These are located at Cape Canaveral, Bermuda, West Australia (not Woomera), Point Arguello, Guaymas, Mexico, in addition to Hawaii.

The *beamwidth* (not bandwidth) of the acquisition system is about 20 deg at the 3-db points, but it is capable of acquiring signals arriving from 15 to 18 deg off its axis. A 160-dbw signal is not normally received from the capsule; in fact, if it were, there is some doubt that the acquisition system could cope with it. *Minus* 160 dbw is more nearly what is expected.

A 10-ft dish is used on the Verlort, not a 12-ft one. While this radar probably will not operate at greater than 700 miles range on the Mercury flights, due to line-of-sight limitations, it has successfully tracked targets at 1,200 miles and is theoretically capable of over 2,500-miles range. It is not clear what was meant by "acts as a controlling source by the acquisition system for directing other antennas," but it should be pointed out that the Verlort is one of the primary sources of tracking data, and is not simply a means of providing pointing information for other antennas.

The quad helix array used for the acquisition system does have a dipole array mounted on it, but this dipole is for the h-f 15-30-Mc range, not for 1,530 Mc. It might be noted that the quad helix also serves for uhf voice communications and telemetry signals . . .

A. S. MARKHAM
BALTIMORE, MD.

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Bendix Bulletin

ANOTHER BENDIX FIRST! 120-VOLT, 110°C. DAP TRANSISTORS

Exclusive! Available with Cerameterm terminals that set new reliability standards*

Here's important news for you if you're a design engineer. New Bendix 10- and 25-amp DAP® diffused alloy power transistors switch high currents *in microseconds.* They also offer low input resistance for increased circuit stability over a temperature range from −60°C. to +110°C.

That's not all you get with these new DAP transistors. They're also available with new Cerameterm (ceramic-metal terminal) bases specially developed by Bendix for extra reliability in severe applications demanding high performance.

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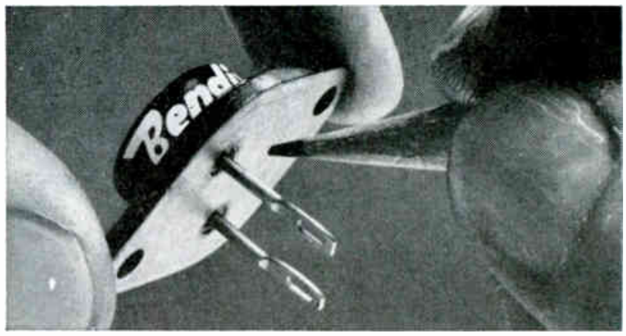

Type Number	Absolute Maximum Ratings				Electrical Characteristics Current gain	
	Vce Vdc	Ic Adc	Pc W	Tj °C.	hFE	@Ic
2N 1073	40	10	60	110	20-60	5 Adc
2N 1073A	80	10	60	110	20-60	5
2N 1073B	120	10	60	110	20-60	5
*BC 1073	40	10	60	110	20-60	5
*BC 1073A	80	10	60	110	20-60	5
*BC 1073B	120	10	60	110	20-60	5
B 1274	40	10	60	110	50-120	5 Adc
B 1274A	80	10	60	110	50-120	5
B 1274B	120	10	60	110	50-120	5
*BC 1274	40	10	60	110	50-120	5
*BC 1274A	80	10	60	110	50-120	5
*BC 1274B	120	10	60	110	50-120	5
**2N 1430	100	10	60	110	20 min. 30-120	10 Adc 5
2N 1651	60	25	100	110	20 min.	25 Adc
2N 1652	100	25	100	110	20 min.	25
2N 1653	120	25	100	110	20 min.	25

*The BC DAP transistor series uses Cerameterm ceramic-metal terminals for increased reliability.
**Designed to meet SCL 7002/25A.

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ELECTRONICS NEWSLETTER

Determine Upper Limit for Component Packing Density

MICROMINIATURIZATION by mere reduction in size may be approaching a limit at which failure probability increases rapidly with decreasing size. Attempts to make smaller elements operate with acceptable system reliability may result in larger packages due to the need for redundant elements.

RCA Laboratories is performing a study for USAF's Cambridge Research Lab aimed at determining how small electronic structures can be made. Report released recently shows that fundamental physical phenomena place an absolute upper limit on packing density of non-redundant semiconductor devices whether integrated or nonintegrated. These phenomena include statistical variations in impurity distribution, maximum resolution of semiconductor fabrication methods, power density, influence of cosmic rays.

For a medium-sized computer system (100,000 components) with a reasonable failure rate (one month between computer failures), the minimum component size appears to be 10 microns on a side. This is not far from the density of devices now in the planning stage and probably within reach of existing techniques, the report indicates. Air Force will consider remedies from a systems point of view (redundancy, self-organizing systems, etc.) to increase volumetric efficiency beyond the limit on packing density.

Industry Group Reports Rise in Money Troubles

ELECTRONIC INDUSTRIES Association reports that 42 electronics manufacturers experienced financial difficulties during the 12 months ended March 31, compared with 39 during the like period 1959-60. Twenty electronics distributors were similarly involved, as against 15 the previous fiscal year.

The EIA's credit committee also reports increases in liabilities among manufacturers and distributors: manufacturer liabilities totaled $19,229,000 against $7,815,000 for the previous period; comparable figures for distributors were $2,684,000 against $2 million for the year before.

Incompetent management heads the list of failure causes, the committee says; other factors include insufficient or unprofitable sales, accounts-receivable difficulties, and slow-moving or excessive inventories.

Air Force to Outfit B-52 With Improved Bomb-Nav

AIR FORCE will spend more than $100 million for a new bombing-navigation system for the B-52 bombers of the Strategic Air Command. AC Spark Plug division of General Motors is systems integrator for the all-weather bomb-nav project; Air Force has already released $20 million to AC for the development of the system. System should give the B-52 a low-level flight capability and permit it to tie in with air-launched ballistic missiles.

In another defense development last week Navy announced that it will soon award a $20-million contract to GE for continued production of long-range height-finding radar systems.

West Germany Offers Help In Space Communications

FEDERAL REPUBLIC of Germany last week offered to contribute between $3 million and $5 million toward the start of a transatlantic space communications system. The move adds West Germany to the cooperative effort already underway between Britain, France and the U. S. (For another space communications development, see Washington Outlook, p 14).

Also last week, the assistant chief engineer of AT&T told the National Association of Broadcasters that one of the big advances of the 1960s will be the use of space satellites for handling global television. Jean Felker discussed a broadcasting system of some 30 to 50 satellites in equatorial orbits 22,000 miles high (the critical distance at which the satellite will appear to be motionless). Felker noted that the idea had been in development for many years, was made more feasible by recent authority granted the Federal Communications Commission.

Soviet Radar Scans Venus, Revalues Astronomical Unit

WITH THE HELP of a powerful radar, Soviet scientists claim to have measured the speed of Venus's rotation on her axis and recalculated the astronomical unit. The Venerian day is calculated as between nine and eleven days, based on doppler data (or, as Soviet news agency Tass puts it, on "a widening of the frequency spectrum caused by the revolution of the planet"). Value of the astronomical unit—the mean distance between the earth and the sun—came out to 149,457,000 Km ± 5,000 Km (92,872,580 ± 3,100 miles).

Radar used to scan the surface of Venus was "in the middle of the decimeter band," probably about 1,000 Mc. Output was quoted by the Soviet Academy of Sciences as being 250 Mw per steradian, putting some 15 w on the surface of Venus. (A steradian is a solid angle roughly equivalent to a 30-deg right circular cone. U. S. observers consider it highly unlikely that so broad a beamwidth was used; the output power in front of the reflector was probably around 400 Kw or less focused in a conventional 1-deg beam or even tighter. Antenna gain was probably also quite high.)

Radar used circular polarization. Antenna with linear polarization was used for reception.

Japan Eases License Rules, May Cut Transistor Prices

JAPAN's Ministry of International Trade & Industry has succeeded in persuading the Finance Ministry to ease off on the red tape involved in executing technical license agreements with overseas technology. Since the Ikeda government liberalized foreign investment regulations on April 1, MITI has been giving quick approval to license agreements only to have them bog down for lack of currency allocations. Beginning June 1, Finance Ministry will stop reviewing each case and permit automatic approval of license agreements approved by any other authorized government agency. Three exceptions to this easier procedure: when Japan's exports are expected to be jeopardized, when domestic industry might get hurt, when domestic research will be stunted.

In another development, six transistormakers last Monday asked MITI to cut the export price for a kit of six transistors and one diode, currently $2.99, to $1.50 or $1.60, and to discontinue the discount rates for large consignments. The six feel such a cut would be in line with the reduction on April 1 of the export floor for six-transistor radios to $6.50. The manufacturers are Hitachi, Toshiba, Nippon Electric, Sony, and Kobe Kogyo. MITI had no comment, is believed to favor the reduction.

Automatic Controls Aid Watthour-Meter Competition

FOREIGN COMPETITION has been squeezed out of the watthour-meter and instrument-transformer market in the U. S., says D. E. Craig of GE's meter department. Craig attributes the achievement to reductions in costs, improvement in service, arising from increased automation. GE uses computer controls for manufacturing, parts inventory, finance, warehousing at its Somersworth, N. H., meter plant. Recent addition: toy-train technique for soldering meter assemblies; in place of conveyor-type production line, meter rides to various stations on a frame that travels around a track like a toy train.

Range-Measuring Doppler Described at Conference

DOPPLER radar system that can measure both range and speed of a single moving object among many stationary objects was described at the Aerospace-Electronics Conference in Dayton, O. The system was developed and described by Ford Motor Co. scientists.

System uses both the doppler effect and phase modulation of the transmitter signal. Two audio-frequency signals result in the receiver; comparing the ratio of the amplitudes of these two signals permits measurement of the distance from radar to target. Target velocity is conventionally obtained by doppler measurement. System operates above the X band; among other uses postulated by Ford scientists is surveillance equipment for infantry tactical units that would detect personnel movements in wooded country. More to the point from Ford's point of view; the system can be used for proximity warning to sense the existence of obstacles in the path of automobiles.

Patent Group Seeks Accord with USSR

NATIONAL PATENT Development Corp., which markets patents for some U. S. industrial concerns, is sending a technical mission to the Soviet Union to engage in discussions with the All-Union Chamber of Commerce of the USSR with the aim of establishing a liaison for licensing and cross-licensing of patents. Soviet industry, which does not recognize patents taken under national authority outside the USSR, has always been rather a thorn in the side of Free World technology. Patent Development Corp. will seek to arrange payments and royalties in both directions for shared technology.

Ghana Station Will Help Communications Studies

RECEIVING STATION operated by the University of Ghana in Africa has been added to the U. S. Air Force research network for intensive study of communications blackouts and multipath delays. Air Force Cambridge Research Labs have for years maintained experimental transmission paths linking Boston with Thule, Greenland; Fairbanks, Alaska; Kiruna, Sweden, and Oslo, Norway. A second station was recently set up near Boston, in addition to the one in Ghana.

Transmissions are in the 3 to 30 Mc band. The Ghana site, on the geomagnetic equator, is expected to provide a more comprehensive worldwide picture of blackout phenomena, known to be related to ionospheric disturbances and magnetic storms caused by solar events.

Social Security Agency May Install Data Net

SOURCES in the Department of Health, Education & Welfare have hinted to ELECTRONICS that the Social Security Administration may soon install data-transmission equipment to connect its various field offices. Strongest contender is believed to be Digitronics' Dial-o-verter gear, which sends over Bell System dial networks at 100 characters a second. Dial-o-verter can send and receive on punched cards, paper tape or magnetic tape. One result: employers who now send form 941 by mail to Baltimore on magnetic tape may in future simply send it over the telephone.

Study Methods to Detect Underground Explosions

GEOPHYSICISTS at Pennsylvania State University are using simulation to study the differences between natural seismic phenomena and underground explosions in the earth in an attempt to arrive at a reliable method for detecting underground nuclear blasts. The scientists have built a flat model of the earth, a plastic disk ⅛ in. thick and 26 in. in diameter. A small hole is cut in the center of the disk and "ground motions" are simulated from this point.

Elastic waves from earthquake sources are simulated by combinations of piezoelectric crystals; changes in position and phasing permit simulation of many different types of forces. Explosions are simulated by a single crystal. An artificial shear stress is simulated by freezing water so as to hold two stressed plastic plates in position; thawing the water relieves the shear stress and creates elastic waves similar to those caused by slippage along natural faults in earth strata. Sensitive detection instruments are mounted on the circumference.

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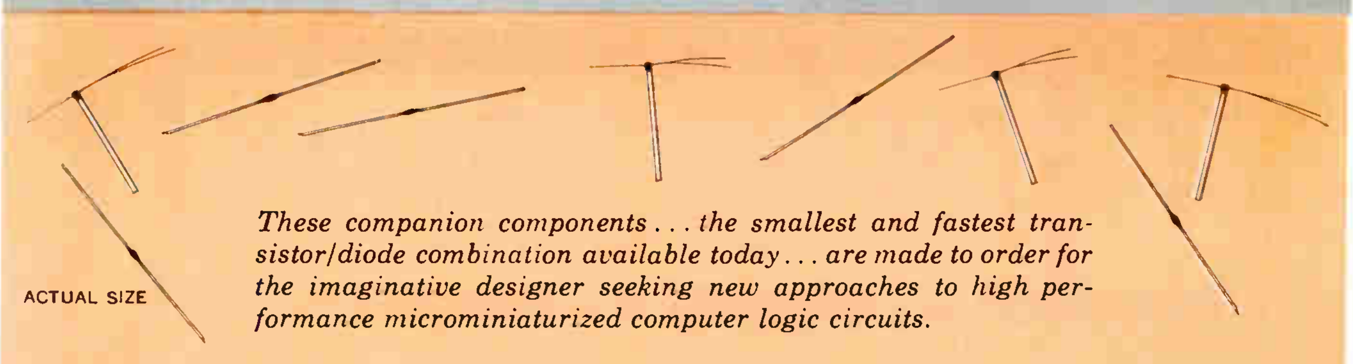

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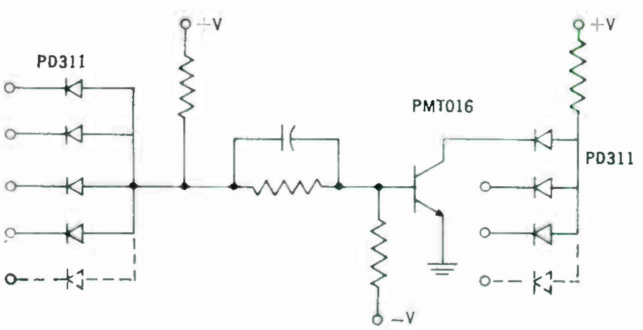

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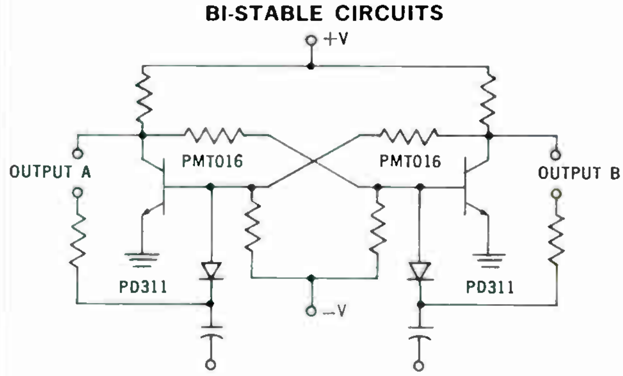

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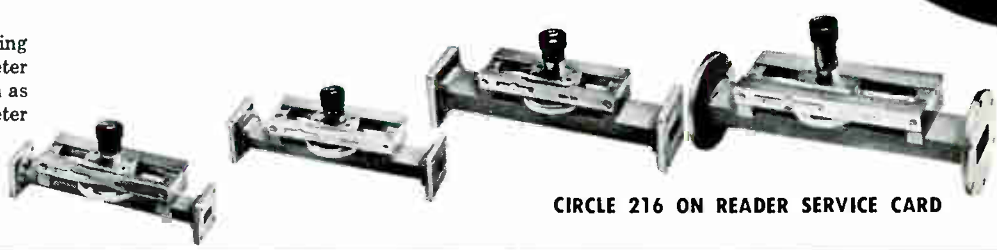

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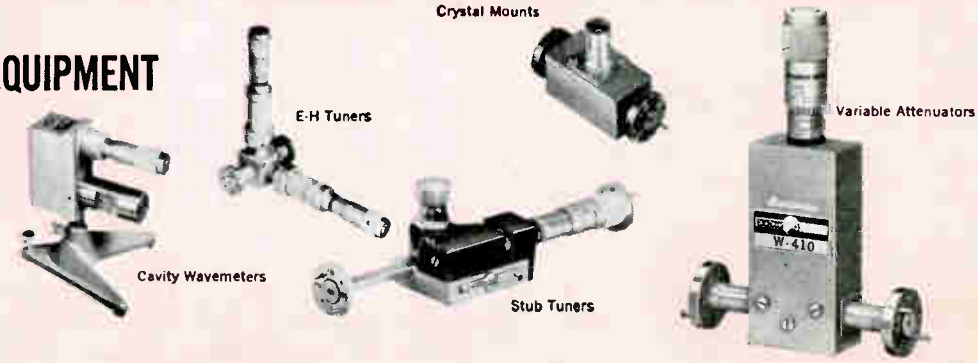

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WASHINGTON OUTLOOK

ORGANIZATIONAL DETAILS and key positions of the Air Force Systems Command have now been ironed out. For contractors, the major effect will be simplified management of projects. Review and approval by several bureaucratic levels will be kept to a minimum. Control over projects will be centered in system program offices that will be responsible from conception to production.

No significant procurement policy changes are contemplated for now. But in aeronautical systems, the new command intends to delegate more authority to prime contractors for qualification and approval of subcontractors. Still, officials stress that subcontracting will continue to be pushed and primes will be discouraged from building up capacity that subcontractors already have.

There will be no general policy on technical approaches and procurement methods for new projects—that is, whether the single weapon system prime contractor approach, the B-70 bomber, for example, or the associate contractor system, for example, the ICBMs, is to be selected. Each case will be decided individually.

The decision on how to manage new projects will depend on the interdependence of subsystems, overall experience of the system contractors, the Air Force's experience in handling similar projects and the extent to which the state of the art is being taxed.

The Systems Command was set up last March in an Air Force reorganization. The command took on contracting responsibilities for both research and development and for production, and was built around the former Air Research and Development Command. The Air Materiel Command, formerly the production contracting agency, became the Air Force Logistics Command with severely reduced contracting responsibilities.

Electronics contractors will deal with each of the Systems Command's four divisions: Ballistic Systems, Inglewood, Calif.; Space Systems, Inglewood; Aeronautical Systems, Dayton, Ohio; and Electronic Systems, Bedford, Mass.

Air Force basic research functions, formerly centered in ARDC, are now managed by the Office of Aerospace Research (OAR), headquartered here under the service Chief of Staff.

The Air Force's Cambridge Research Laboratories at Bedford, which sponsors basic and applied research in electronics, is now a unit of OAR.

A PROJECT in Italy has been opened up for bids from U. S. electronics producers under NATO's competitive bidding procedures. The project calls for production and delivery of six single-channel vhf transceivers; five single-channel uhf transceivers; one multichannel vhf transceiver; and one multichannel uhf transceiver.

Applications for bids can be obtained from the Commerce Dept.'s Trade Development div., Bureau of Foreign Commerce in Washington, Project No. 9961. Bids will be sent to Ministero Difensa Aeronautica-Ispettorato Telecommunicaxioni ed A. V. Ufficio NATO-VEW, Viale Castro Pretorio, Rome. Invitations to bids will be sent to qualified companies about July 26. Bids will be opened about August 16.

RADIO CORP. OF AMERICA has won a $3.2-million contract to build an experimental communications satellite for the National Aeronautics and Space Administration under Project Relay. Selected from six other companies who made proposals, RCA is to build a 100-lb active repeater satellite capable of handling 600 simultaneous telephone calls or one television channel. Launching of the satellite into a 1,000- to 3,000-mile-high orbit is expected by mid-1962.

The British General Post Office and the French Center for Telecommunications Studies will provide ground stations in Europe for transmission of multichannel telephone, telegraph and television signals. Award of the RCA contract is not expected to effect industry's efforts to build a privately-owned communication satellite system later on.

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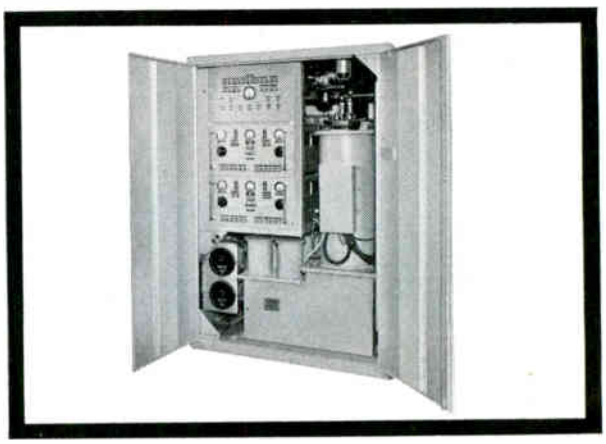
Write to: Litton Industries, Electron Tube Division, San Carlos, California. Or better still, phone: LYtell 1-8411.



Transmitters for the Air Force Search Radar AN/FPS-20, built by Bendix Radio Division of the Bendix Corporation for the Rome Air Development Center, Air Research and Development Command.

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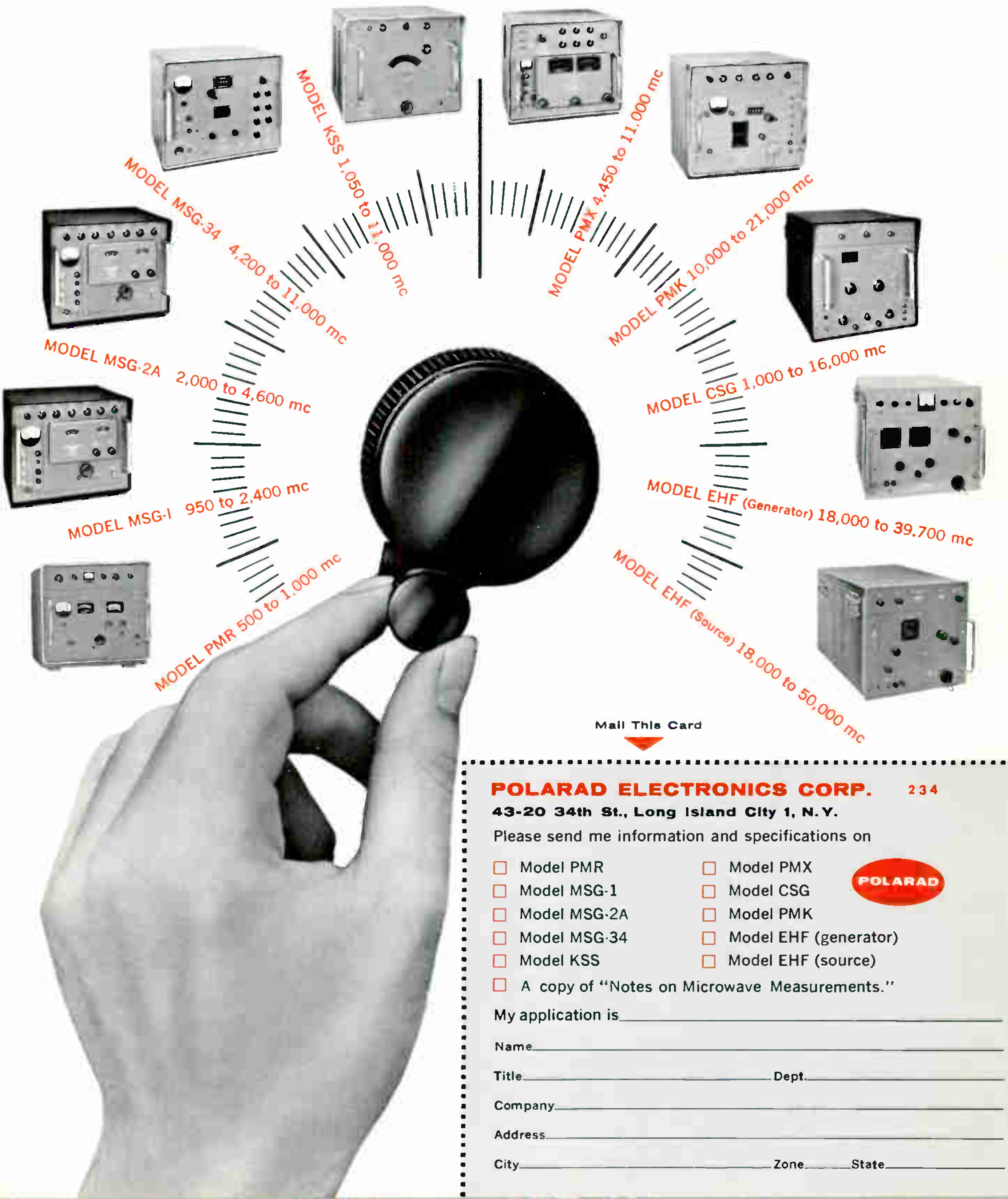

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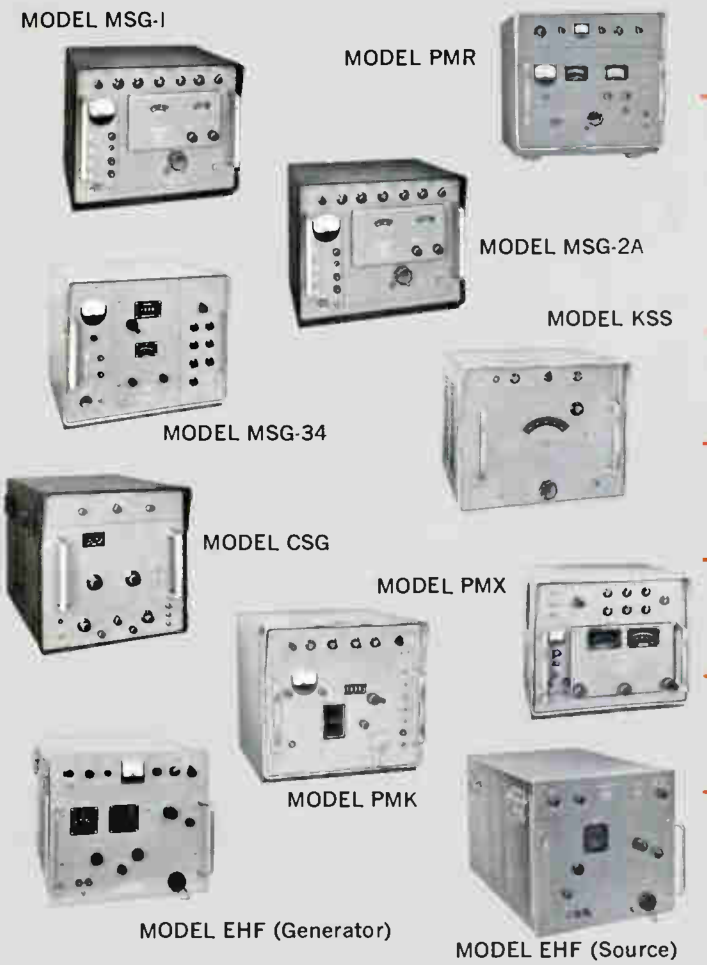

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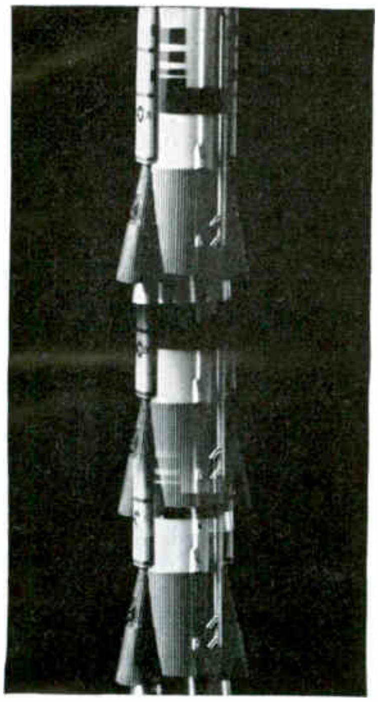

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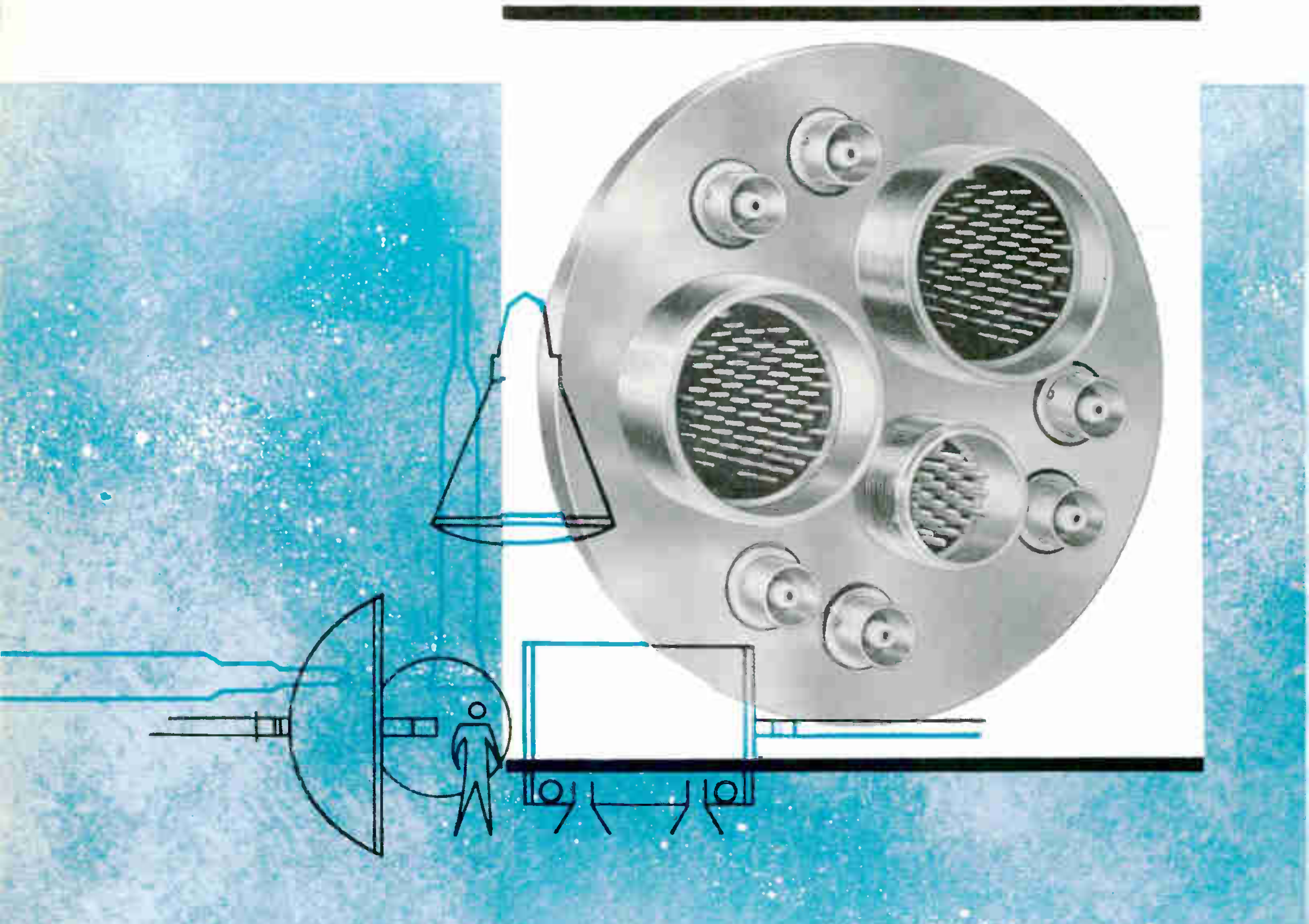

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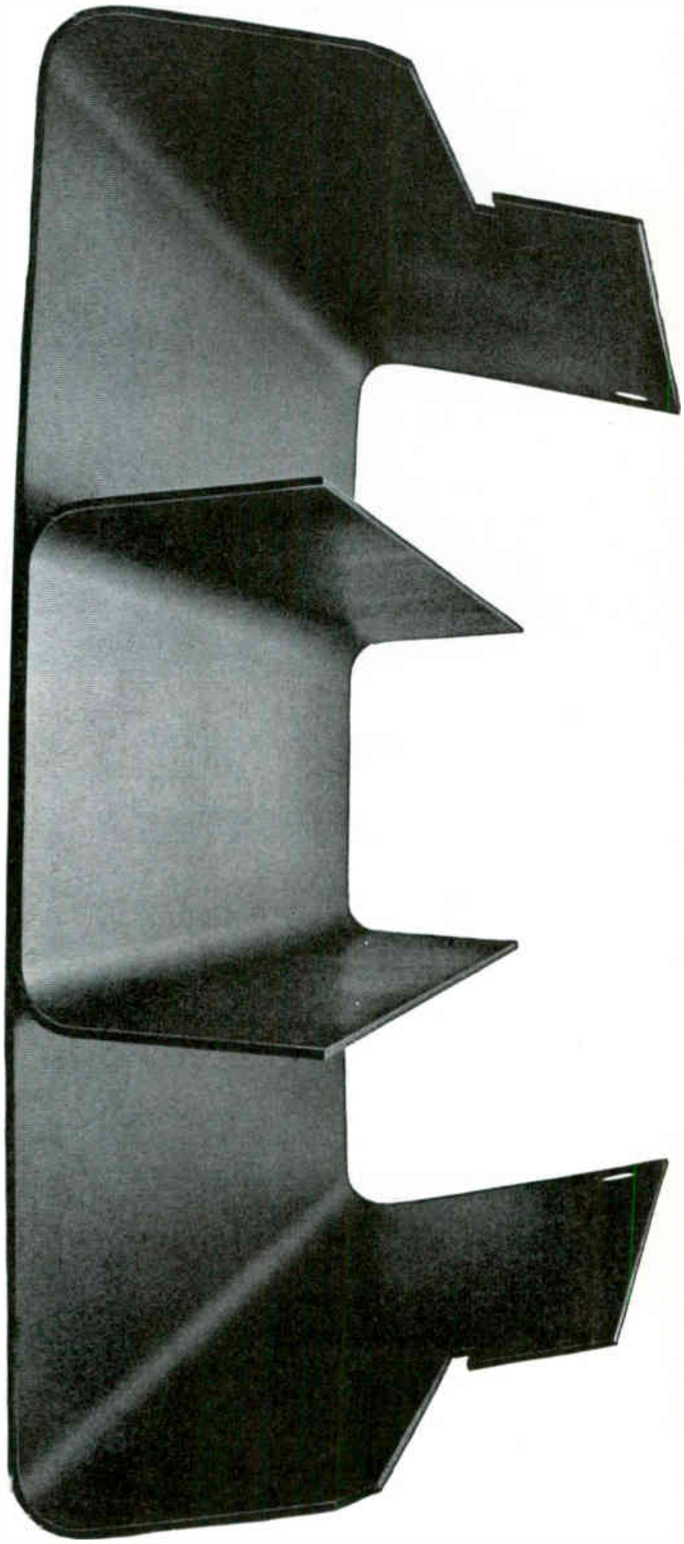

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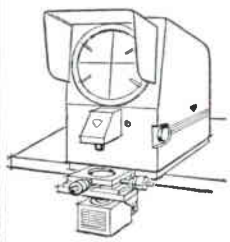

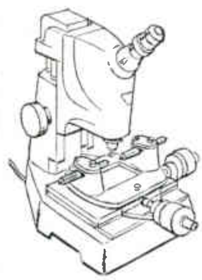

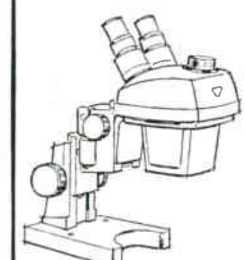

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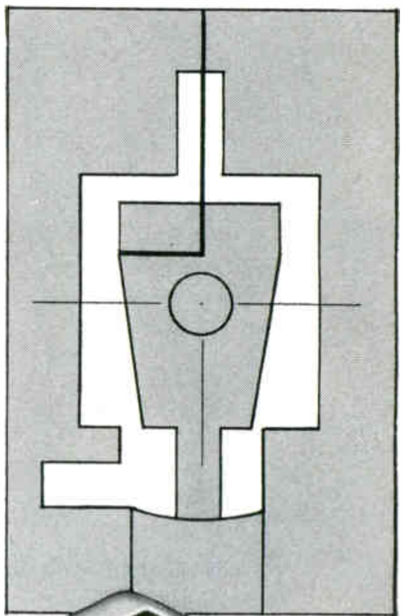

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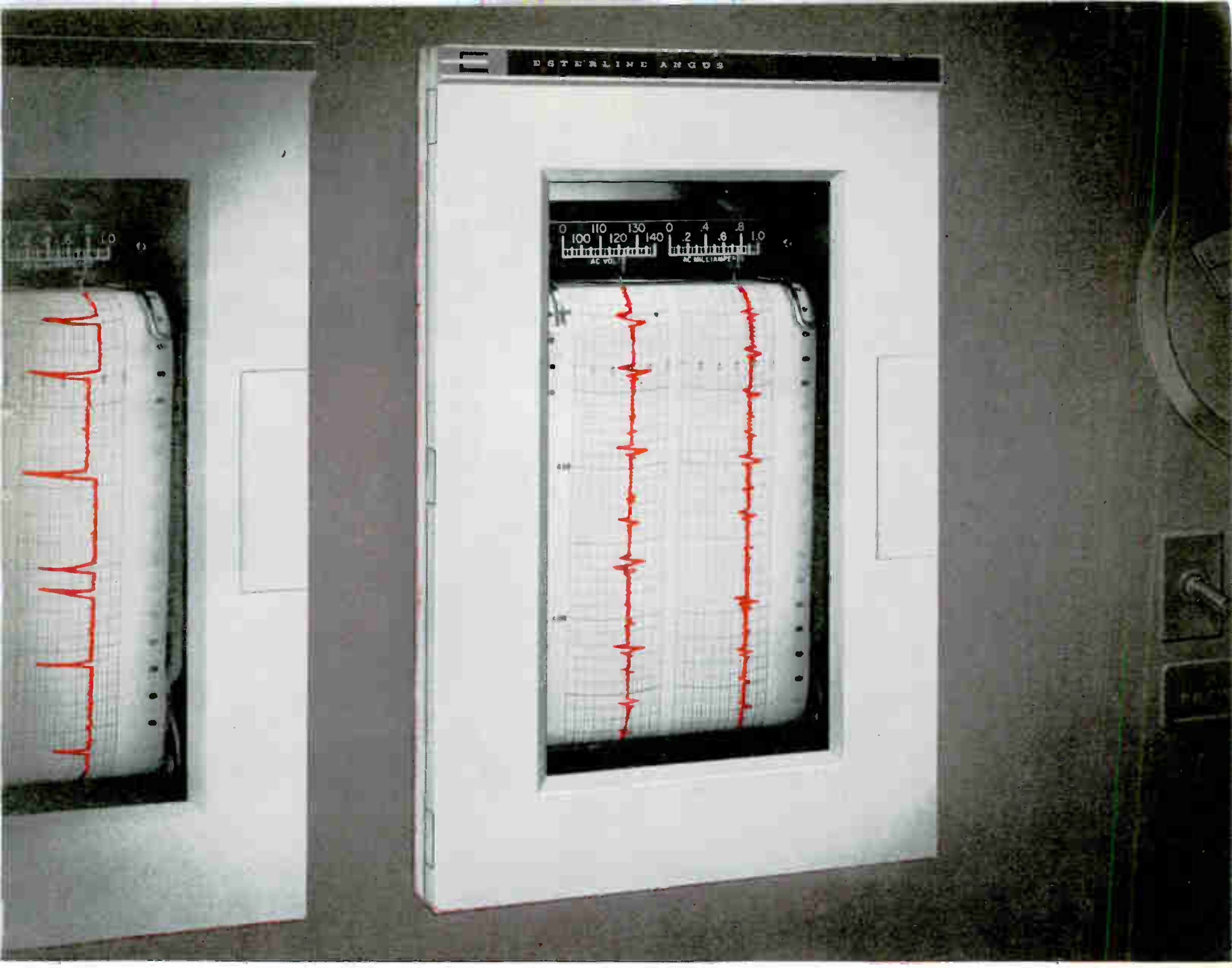

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New "602" Esterline Angus Two-channel Recorder

This compact two-in-one instrument provides side-by-side synchronized graphs on a single six-inch-wide chart! Use it to check electrical circuits, to determine the quality of arc welds, to indicate proper settings for anodizing, to aid in medical diagnostic research, to provide a wide variety of other vital information. In fact, *any* two variants if expressed as current or voltage can be recorded simultaneously on this new two-pen instrument.

Price? Under $600. That's some $150 less than the cost of two graphic instruments previously required to do the same jobs!

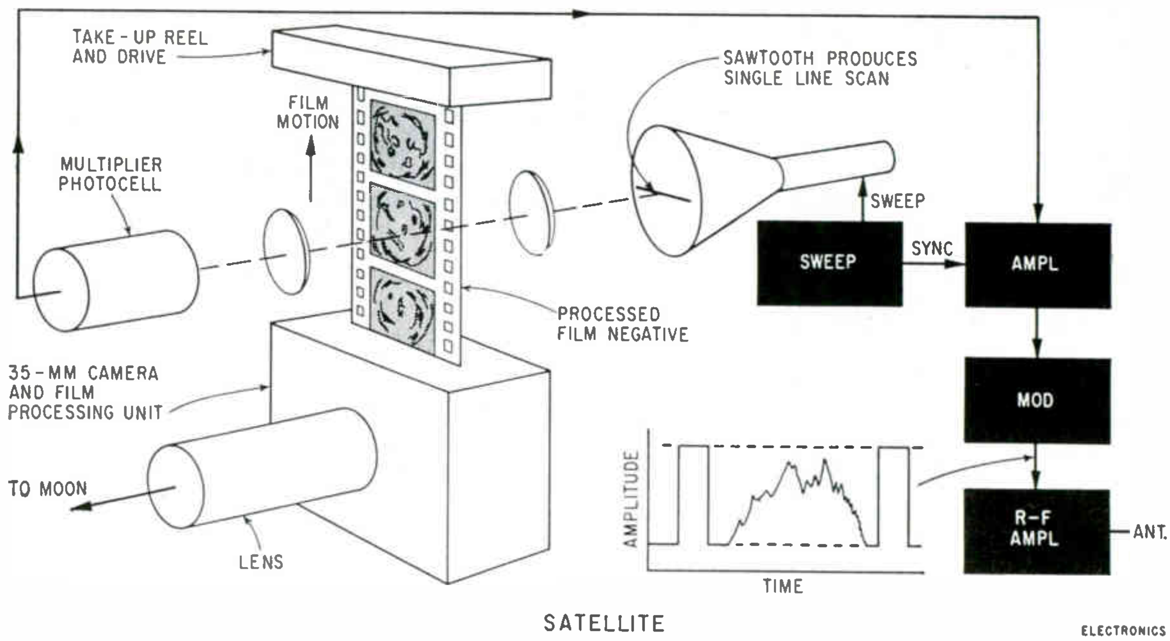
Most important, the Esterline Angus Two-channel Recorder (which carries a unique-in-the-industry two year guarantee) is a product of 50-plus years of experienced craftsmanship — your assurance of dependable, trouble-free performance.

For more detailed information, write for new "602" Recorder descriptive sheet. Address: Esterline Angus Instrument Company, Inc., Box 596E, Indianapolis 6, Indiana.

E. G. McDowell, Master Craftsman at Esterline Angus for 48 years.

Excellence in graphic recording for over 50 years—ESTERLINE ANGUS

CIRCLE 23 ON READER SERVICE CARD



Simple photo system, used in Soviet lunar probe to take pictures of moon, employs electronic scan for horizontal sweep and mechanical motion for vertical.

HERE'S HOW THE RUSSIANS

By LESLIE SOLOMON,
Associate Editor

SOVIET ENGINEERS often appear to be masters in the design of uncomplicated, unsophisticated electronic equipment. The method used to take pictures of the far side of the moon, process them, transmit the pictures to Earth and reproduce them might appear to be the work of a technical high-school student —yet the method works and works well. The method of removing noise bursts from the pictures is equally simple.

The sketches show operation of the satellite and ground station equipment. The satellite used a 35-mm camera with two parallel axis lenses, one of 200-mm focal length and the other of 500-mm length. The apertures were 1:5.6 and 1:9.5 respectively.

Pictures were taken on command and about 30 were made in a 40-minute interval when the satellite was in position. After the pictures were taken, the film passed into a processing unit where it was developed, fixed, washed and dried.

The finished negatives were then scanned by a single-line, constant-brightness trace generated on a small cathode-ray tube. The beam moved slowly and evenly across the screen and made a rapid retrace at the edge. Vertical sweep was obtained by slow and even mechanical motion of the film into a take-up reel.

After passing through the film, the light beam, now modulated by picture information, was picked up by a multiplier photocell. The photocell output and the horizontal sync signal were then amplified and passed to a modulator and r-f unit for transmission to Earth.

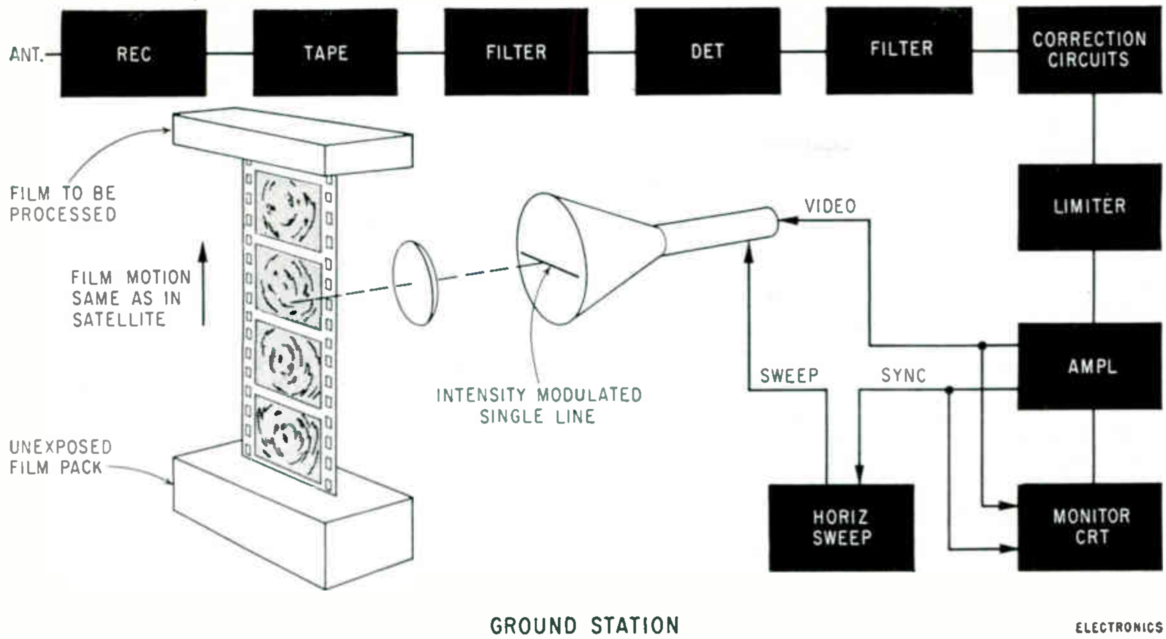
Unretouched lunar photograph clearly reveals noise bands

The signals were received at the ground station and recorded on magnetic tape before demodulation. A series of adjustable filters and correction circuits was included to reduce the effects of distortion and noise in the signal channel.

The received sync signals lock the ground station cathode-ray tube electron beam to its counterpart in the satellite while the demodulated video information intensity-modulates the beam. The light beam scans across unexposed film that is being drawn vertically at the same rate as in the satellite. The film is then processed. There is probably another sync signal to keep the two take-up reels locked in speed.

Received video and sync are also fed to a long-persistence cathode-ray tube monitor where the video can be observed and photographed.

Some photographs were heavily fogged with noise bands due to low signal-to-noise ratio. On all photographs, periodic noise bands are



One line of transmitted signal is shown at lower right of satellite sketch. Ground system uses a similar electromechanical technique to reproduce photos

PHOTOGRAPHED THE MOON

visible (see photo). These were produced by variations in received signal intensity due to satellite rotation. The frequency and density of the noise bands are not identical in the one-after-the-other frames. Defects in film emulsion also contributed to some fogginess.

Optical distortions were removed by superimposing frames of the same area on each other by aligning certain reference points that appeared on the pictures. This resulted in an average divergence of 0.2 mm along the scanning lines and 0.6 mm along the vertical sweep for image dimensions of 10 to 25 cm.

A certain amplitude level of the received video signal curve (see small sketch within satellite box) was chosen as a cross-over point. All signal levels above that line are recorded as white and all signal levels below that line are recorded as black. The level line was chosen after observation of a picture and could be varied to suit picture content.

Altogether, 499 features were classified according to the order of their reliability. First category features: reliable formations with clear outlines—252; second category: those with less clear outlines—190; and third category: those whose outlines require further determination—57.

Electronics Firms to Get Bigger Role In Ship Design

FOR THE FIRST TIME, Navy is attempting to merge naval architecture and electronic systems engineering in the initial design of ships, Rear Adm. R. K. James, chief of the Bureau of Ships, revealed last week. The goal: greater compatability of shipboard electronic systems.

Navy's effort is being divided among three prime contractors (cost-plus-fixed-fee)—each to work on a representative ship type. The three companies, Navy says, will (1) develop a proposed whole ship electronic system, including structural, installation and maintenance aspects; (2) submit recommendations for modification, procurement and development requirements in support of the above; (3) submit cost and value analysis of the system; and (4) submit schedule of feasibility analysis.

Electric Boat Div. of General Dynamics under a $790,000 contract will provide an electronic system design for a nuclear-powered attack submarine. Hazeltine's $751,000 contract covers the design of an electronic system for a guided missile escort vessel. The Alpha Corp., subsidiary of Collins Radio, has a $1,438,000 contract to design the electronic system for a guided missile frigate.

Electric Boat's subcontractors are ITT, Raytheon, Hughes, Librascope Div. of General Precision, RCA, and Autonetics of North American Aviation.

Subcontractors for Hazeltine are Newport News Shipbuilding and Dry Dock for investigating structural design and installation problems; Development Engineering to survey antenna engineering and installation problems; and Sperry Rand to work with Hazeltine on basic gear and systems studies.

Alpha will head an industrial team comprised of Hughes, Librascope, Edo Corp., J. J. Henry Co. and three divisions of Collins.

Pres. Davis: "Association and Industry at Crossroads"

EIA Tackling Controversial Reorganization Plan

CHICAGO—AT ITS ANNUAL meeting in Chicago this week, the Electronic Industries Association is tackling a controversial and far-ranging reorganization plan. "Our association and our industry are at a crossroads," says Association president L. Berkley Davis of GE.

Members agree that they should overhaul the structure of EIA, but they disagree as to the extent of reorganization. An EIA committee presented a plan for reorganization that would set up 12 divisions in place of the present five to take care of new products areas. Each division would be headed by a board of directors.

They in turn would report to a board of governors.

Many EIA members believe this is too cumbersome and adoption of the committee plan is questionable. More divisions than the present five undoubtedly will be set up, but gradually.

For example, the existing Industrial Division could be broken up so that there would be a separate Computer and Data-Processing Division. This Davis describes as a "multi-million dollar business with wide areas of the market untouched."

Another needed division, he says, is Satellite Communications, "a gigantic new industry."

The reorganization committee also says the electronics industry should be redefined to determine who is eligible for membership in the Association. Also there will be a move to set up a new charter to spell out the responsibilities of the Association. "It is a spokesman for the industry," executive vice president James Secrest says, "but in what areas?"

There will be some changes in finances. One problem has been a dues ceiling. Dues have been based on the first $30 million of a company's sales but that provision is said to be outdated.

Two plans have been under consideration: to raise the ceiling arbitrarily or to have several brackets.

Another item of business is a "grass-roots" public-relations program aimed at resisting the inroads of foreign-made electronic products. Association members plan to work through Chambers of Commerce, civic groups and individuals. They look for support in Congress; about 200 members of Congress have electronics plants in their districts. "EIA will continue to resist unfair competition from nations with wage rates a fraction of ours," Davis says.

EIA will be pushing two specific legislative programs: reorganization of the Federal Tariff Commission and revision of federal income tax regulations.

According to discussions underway, the Association will work with the Trade Relations Council on a plan for a new type of Tariff Commission. (TRC is successor to the Tariff League.)

The plan would provide for experts in various fields rather than political appointments. Also, the new plan would give final power in tariff matters to Congress. At present, if an industry is hurt by imports, the final power rests with the President. Under the new plan, the President could state his case in writing but would need the support of at least one house of Congress. EIA is about ready to circulate an outline of its proposals to its members. The members are likely to endorse it in principle.

The subcommittee on federal income taxation of the EIA Tax Committee has been working for several months on a policy statement representing the views of members. The subcommittee has a program to place before the EIA Board of Directors.

Here are some of the tax recommendations:

- The subcommittee favors legislation to permit taxpayers an allowance for depreciation based on the judgment of the taxpayer consistently applied, and conforming

Swiss Device Makes Change Electronically

Input pulses from cash register activate Sweda's automatic coin changer and provide change to customer in this system developed in Switzerland with generally accepted accounting principles.

• Capital-gains treatment of the disposition of tangible depreciable assets used in trade or business should be limited to the excess of the selling price of the property over original cost.

• The subcommittee says it would support a class-rate depreciation system, with not less than ten classes. The system would provide incentive rates, established by legislation, commensurate with the growth of the economy and the accelerating pace of obsolescence. This system would permit shorter lives than now allowed by the Internal Revenue Code. Class-rate depreciation systems are in use in Canada and most of Europe.

• Legislation permitting formation of foreign-business corporations should be enacted. At least 95-percent of the income of such corporations should result from the conduct of an active trade or business; all their income should be derived from business conducted outside the U. S. The use of foreign-business corporations should not be limited to underdeveloped countries.

• The subcommittee is opposed to legislative proposals that would require the withholding of income tax on cash dividends and interest because it would place too much of a reporting burden on companies.

President Davis reminded the Association that the Secretary of Defense has confirmed the industry's own impression that the shift from manned bombers to missiles has meant more business for the electronics industry.

This year's military expenditures for electronic equipment and research will exceed $5 billion, and "the leveling off is not yet in sight."

The electronics industry, Davis said, has always relied on technological advancements, but they have never been as important as today. Competition for world leadership in space exploration is dependent on these advancements, he said, and electronics is an all important consideration along with propulsion.

The marketing data department estimates that EIA member-companies make up about 80 percent of all electronics sales.

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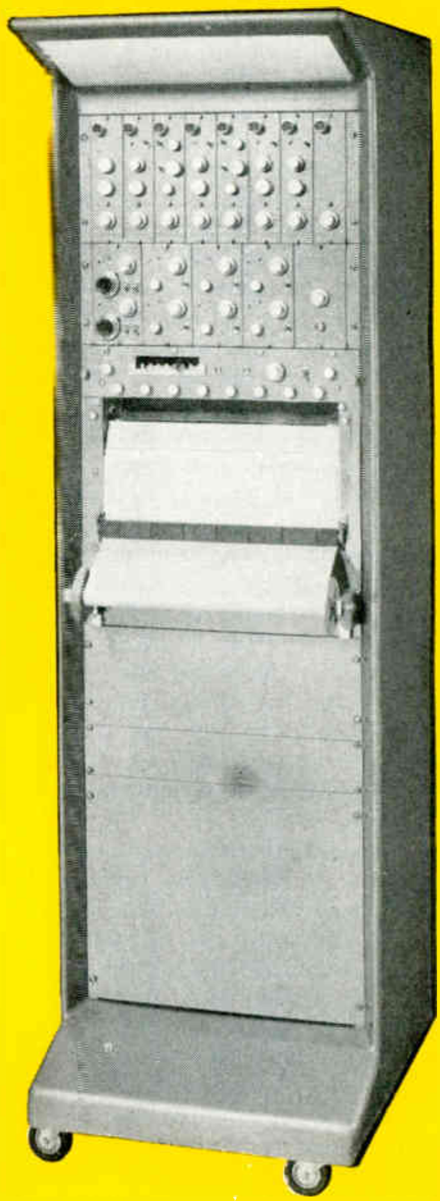

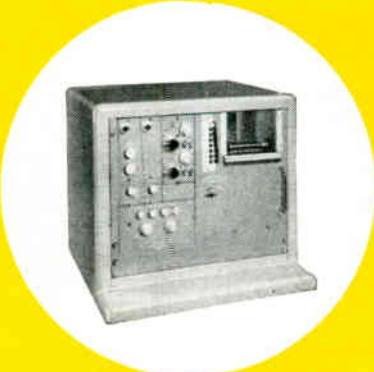

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CIRCLE 28 ON READER SERVICE CARD

Time for Molecular Electronic Institute?

DAYTON, O.—IMMEDIATE creation of a Molecular Electronic Institute and special graduate curricula in this field could aid the U.S. missile program, Jerzy Lubelfield, Wright Patterson AFB, said recently at the 13th annual National Aerospace Electronics Conference here.

Predicting most low power electronic systems will be built of molecular electronic blocks within next five to six years, he urged setting up an Institute as a joint effort of WADD Electronic Technology Lab—a promoter and patron of molecular engineering—and USAF Institute of Technology, to help schools develop faculties and programs in the field, and curricula for graduate students.

More than 1,000 scientists and engineers at the three-day conference heard Lloyd Berkner, IRE president, stress importance of scientific education.

"The community which fails to recognize and meet its need for doctorate or graduate degrees will become a colony of the community that does," he said.

Emphasizing importance of new, much more powerful technology, Berkner sees revolutionary changes in materials during the next few years, resulting in part from use of computers to develop a completely theoretical metallurgy.

Nearly 100 technical papers were presented in 20 sessions shared between Pick-Miami and Biltmore Hotels. In all, 120 booths were sponsored by 70 electronics firms. Recruiting efforts were noticeable with numerous hospitality suites and bulletins distributed door-to-door. More than 600 delegates were cleared for a Wright AFB secret briefing session which closed the conference.

Novel electrometer introduced as a new basic solid-state component by Charles F. Pulvari, Catholic University, permits a tunnel diode to vibrate capacitance junctions in a device capable of sensing charges or small capacitance variations up to the gigacycle region. Suggested applications: detection of mechanical movements without contact, use of automation transducer or to sense electric fields without contact.

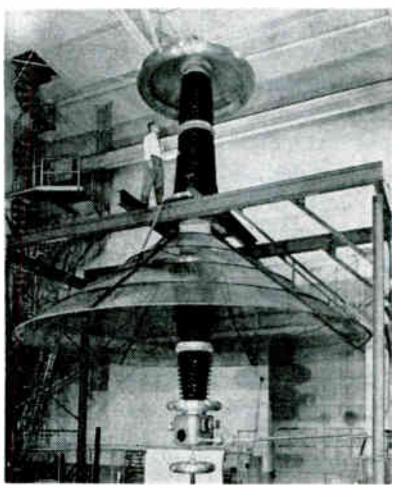
Space platform powered by directed narrow beam of energy would be possibe using microwave energy converter proposed by Lawrence E. Partev, WADD. Present overall efficiency of crossed field converter can be raised by improved coupling from 32 percent to 60 to 70 percent, he said.

Cyclotron resonance converters, now 32-percent efficient at 1.29 Gc, may become 50 to 60-percent efficient with further development. Converters could provide d-c power to actuate unmanned, remotely located equipment.

Antennaverters and antennafiers discussed by Copeland and Robinson, Ohio State, integrate parts of receiver circuits into the antenna structure. The entire receiver, except for output display, may soon be so integrated with advances in solid-state and molecular electronic circuit, according to authors.

Down converter coupled into feed terminals of a conical-spiral antenna provided 7 to 8-db gain. Tw amplifier distributed through antenna structure permits pattern control through adjustment of individual amplifier elements. Providing extremely low noise, preliminary net gain has been measured at 3 db. System may also be suitable for transmission antennas.

Antenna Insulator



Tests by GE of 26-ft insulators for Navy l-f antennas show them corona free at 500 Kv, 60 cps

Reactive parametric amplifier successfully integrated within cylindrical volume of half- and quarter-wave dipoles was discussed by Frost and Clark, University of New Hampshire.

Fast recovery semiconductor modulator permitting interrogation by chain of multiple radars was described by Frederick L. Kock, Motorola. A *pnpn* line-type pulser switches 5,000-watt pulse power in a minimum of 50 microseconds, achieving high efficiency with reactance charging and transmitter stability through variable pulse interrogation periods.

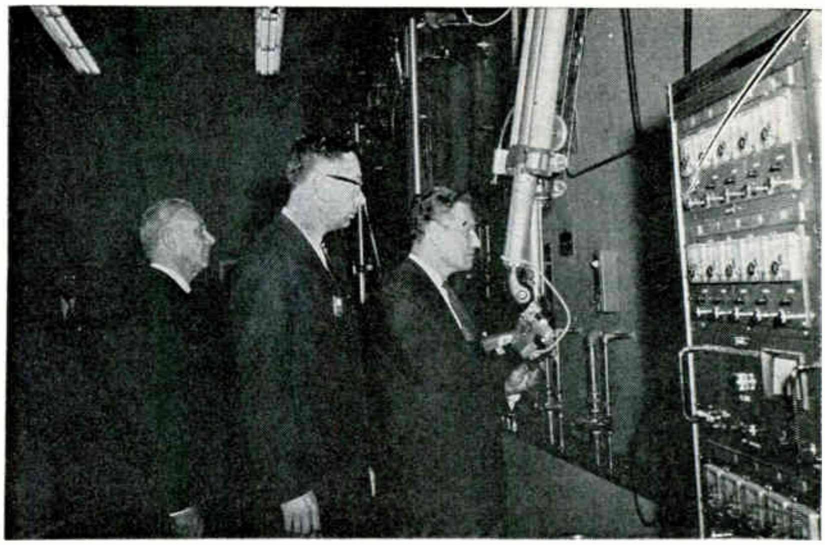
Conductivity meter for measurements through an ICBM wall without electrodes during reentry was discussed by Betchov and Fuchs, Aerospace. Operation depends on interaction of magnetic field with moving conductor.

Adaptive filter for bionic approach to learning and recognition of radar and infrared signatures was described by Frederick Hiltz, GE. Learning process may be either slow and reliable or fast and erratic.

Frequency hopping for more efficient use of spectrum, by automatic switching from one frequency to another, was discussed by Henry Wamboldt, WADD. System would provide 30 db or more protection against jamming as well as a high degree of protection against interception.

Direct-view halftone storage tube permitting selective erasure or simultaneous display was described by N. H. Lehrer, Hughes. Secondary emission accumulates plus charge on storage surface while bombardment induces conductivity charging toward backing-electrode potential, or negatively. Desired effect and charge direction may be chosen by regulating energy of incident beam.

At writing speeds between 10,000 to 15,000 inches per second stored resolution is 40 to 50 lines per inch. At erase speeds between 30,000 to 40,000 inches per second stored resolution is 100 to 120 lines per inch. Stored information may be retained for a minute or more.



New York's Gov. Rockefeller tries electronic manipulator for radioactive materials. J. C. Brantley and August Kinzel of Union Carbide watch

New York Businessmen and Educators Make Plans for New R&D Expansion

RESEARCH AND DEVELOPMENT in electronics and other industries is getting an increased amount of attention in New York State.

Emerging from a number of talks and studies, such as the research and development seminar held recently at Sterling Forest, are patterns that may be reflected in our industry throughout the country.

One trend shaping up for the future is closer cooperation between academic and industrial R&D organizations. Another is the likelihood that companies setting up new research centers will be checking their plans through such non-industry specialists as anthropologists and sociologists before getting down to brass tacks with local municipal authorities.

Major deliniations of these trends are emerging from Gov. Nelson Rockefeller's Advisory Council for the Advancement of Industrial Research and Development. The council is attempting to stimulate research and development activity in the state at the behest of Rockefeller, who warns New Yorkers against complacency bred by past industrial prominence.

Significant to our industry is the fact that almost one-third of the 38-man council is drawn from firms involved in electronics. Companies represented include General Electric, Soundscriber Corp., International Business Machines, Republic Aviation, Airborne Instruments Laboratory and Cornell Aeronautical Laboratory Inc. Some firms have more than one man on the council.

Of the 629 commercial research and development organizations in New York State, 218 are in electronics.

Many representatives of these research facilities were present at a seminar held recently in Sterling Forest, N. Y., at which Rockefeller and a number of prominent educators and industrialists described the needs and future possibilities for research and development in the state.

Rockefeller said the state must assume greater responsibility if goals are to be reached, Although he made no mention of direct financial subsidies, the governor said long-range planning in transportation, housing, education, natural resource use, social services and other aspects of environment needed for research to flourish, were the direct obligation of the state.

Speaking on the need for closer cooperation between industry researchers and their colleagues on the campus, John R. Dunning, dean of Columbia University's School of Engineering, told the group growth industries such as electronics are tied more and more to the academic world.

The value of closer cooperation between schools and companies was also brought out by T. M. Linville, manager of GE's research operations in Schenectady, N. Y.

Charged Engraving Plates Reduce Exposure Time

PROCESS for making newspaper engravings uses electronically charged zinc or magnesium plates, reduces required exposure time from four minutes to a few seconds.

The process called Electrofax, evolved by Radio Corporation of America, makes precoated plates light sensitive by giving them a blanket negative electrostatic charge. The plates can then be placed in a camera and used somewhat like photographic film by exposing them to the illustration or printed material for which engravings are required. After exposure, the coating is removed by solvent and the plates are ready for conventional etching.

An RCA spokesman says the plates have been evaluated by the American Newspaper Association research center and have been tested commercially by engravers of two major U. S. newspapers.

Television Picks Up Missile Contrails

SENSITIVE TELEVISION system is being used by the Air Force to study ICBM and IRBM trails over the Atlantic Missile Range.

Project is under control of the Cambridge Research Labs, aims at improving tracking techniques, understanding physical and chemical perturbations in the upper atmosphere caused by missile passage.

Missiles produce relatively large amounts of exhaust products during powered flight prior to *brennschluss;* these exhaust products are ejected at high velocities into the upper atmosphere. Tv pickup uses image orthicon tube with image intensifier.

Demonstrating a single-head color tv video recording system (Toshiba)

Japanese Pushing Tv and Computers

TOKYO—Right now, Japanese manufacturers are aggressively moving into the television market, especially color tv.

Toshiba has a single-head color television video tape recording system (photo). It's based on the firm's present black-and-white system with more circuits added.

An image orthicon camera, also by Toshiba, is used with color tv cameras. The manufacturer reports he can produce up to 1,000 tubes a year and plans to sell in Japan.

An automatic 16-mm tv film projector is announced by Hokushin Electric. The projector takes color and monochrome and operates automatically once film is marked for stop, insert, light control, and direct scanning. The manufacturer will sell both in Japan and to foreign markets. Retail price in Japan is $7,777.

Japanese television firms are expected to compete with RCA for a contract to set up in Syria the second tv set assembly plant in the U.A.R.

The first plant, opened in Cairo last July by RCA, recently added an assembly line. Its annual output has doubled to 40,000 sets.

The Syrian plant will be state-owned and will have an annual capacity of 25,000 sets, assembled from imported components, under foreign license and supervision.

A computer that analyzes colors, then registers their values numerically and graphically in two minutes was developed by Toshiba's Matsuda Research Laboratory.

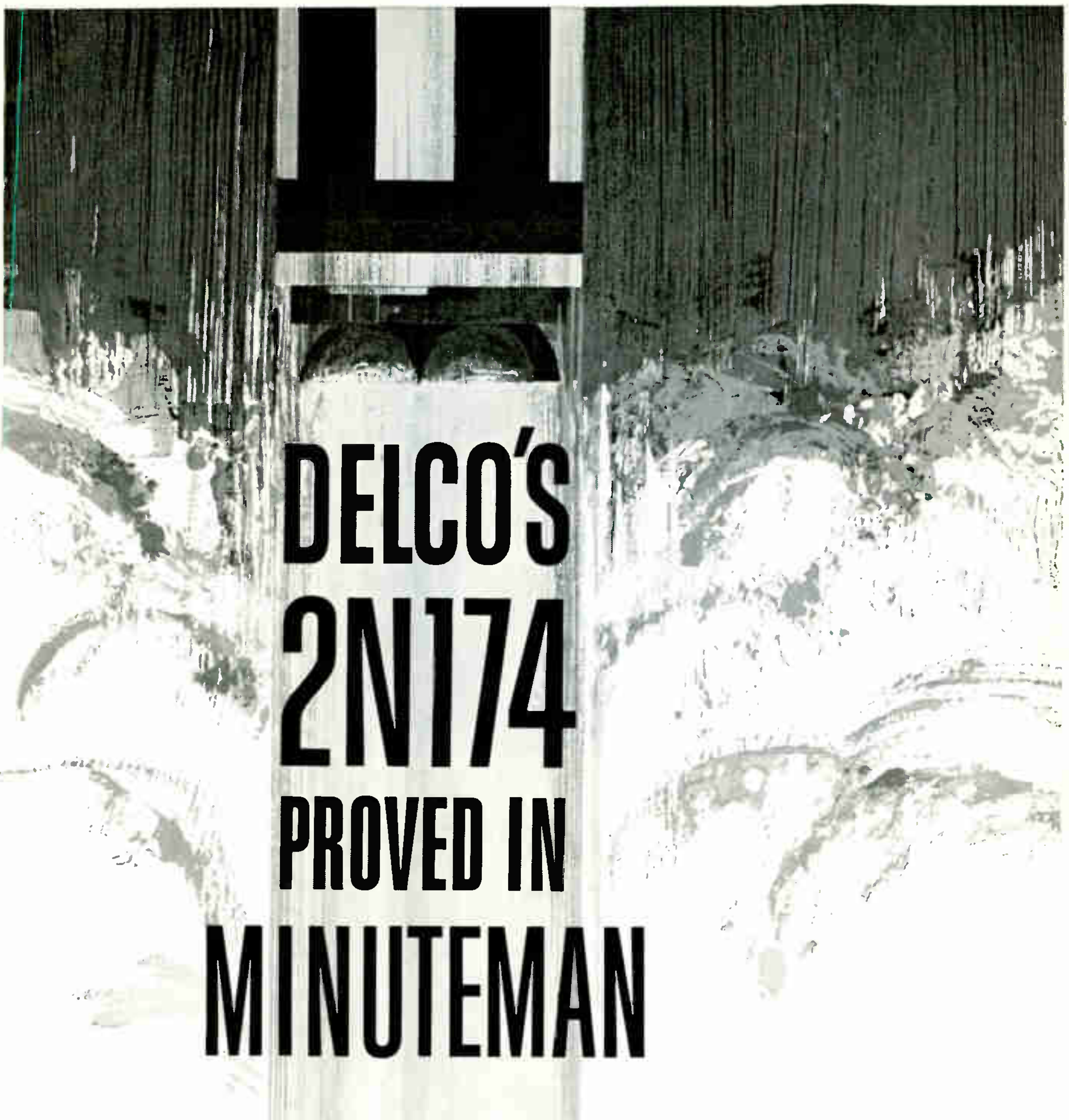
Takashi Azuma, the designer, says the computer combines a spectrophotometer and electronic computer. Error range is within 0.04 percent and error factor in final measurement and computation is 0.1 percent. Price is $27,777.

Toshiba's new data processing computer, TOSBAC-4131 (Toshiba Scientific and Business Automatic Computer), has a memory unit capable of storing 1,000,000 bits. A pushbutton automatically selects up to 15 bits in a fraction of a second. Tape-punching typewriters feed information which is stored on magnetic tape. Price is $111,111.

Magnetic Memory Eases Message Flow

TELEGRAPHIC retransmission facilities installed recently at Brussels National Airport by Sabena Airlines feature magnetic tape memories for storing overload messages during peak periods.

Manufactured by Siemens-Halske, the 16-unit memory semiautomatically serves 18 incoming lines and one of 30 outgoing circuits.



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MEETINGS AHEAD

May 31-June 2: Frequency Control Symposium, U. S. A. Signal R&D Lab; Shelbourne Hotel, Atlantic City, N. J.

May 31-June 2: Radar Symposium, Univ. of Michigan Inst. of Science & Technology; Ann Arbor, Mich.

June 6-8: Instrument-Automation Conf. & Exhibit, ISA, Royal York Hotel, Toronto, Ontario, Canada.

June 8-9: National Electrical Manufacturers Assoc., NEMA; Biltmore Hotel, Los Angeles.

June 11-16: Electronic Representatives Management Inst., ERA & Univ. of Ill.; Robert Allerton Park, Urbana, Ill.

June 12-13: Radio Frequency Interference, PGRFI of IRE; Sheraton-Park Hotel, Washington, D. C.

June 12-17: Components & Materials Conf., Institution of Electrical Engineers; London.

June 14-15: Product Engineering & Production, PGPEP of IRE; Sheraton Hotel, Philadelphia.

June 16-21: Medical Electronics, International Conf., IRE, AIEE, ISA; Waldorf-Astoria, New York City.

June 19-20: Broadcast & Tv Receivers, B&TVR of IRE; O'Hare Inn, Des Plaines, Ill.

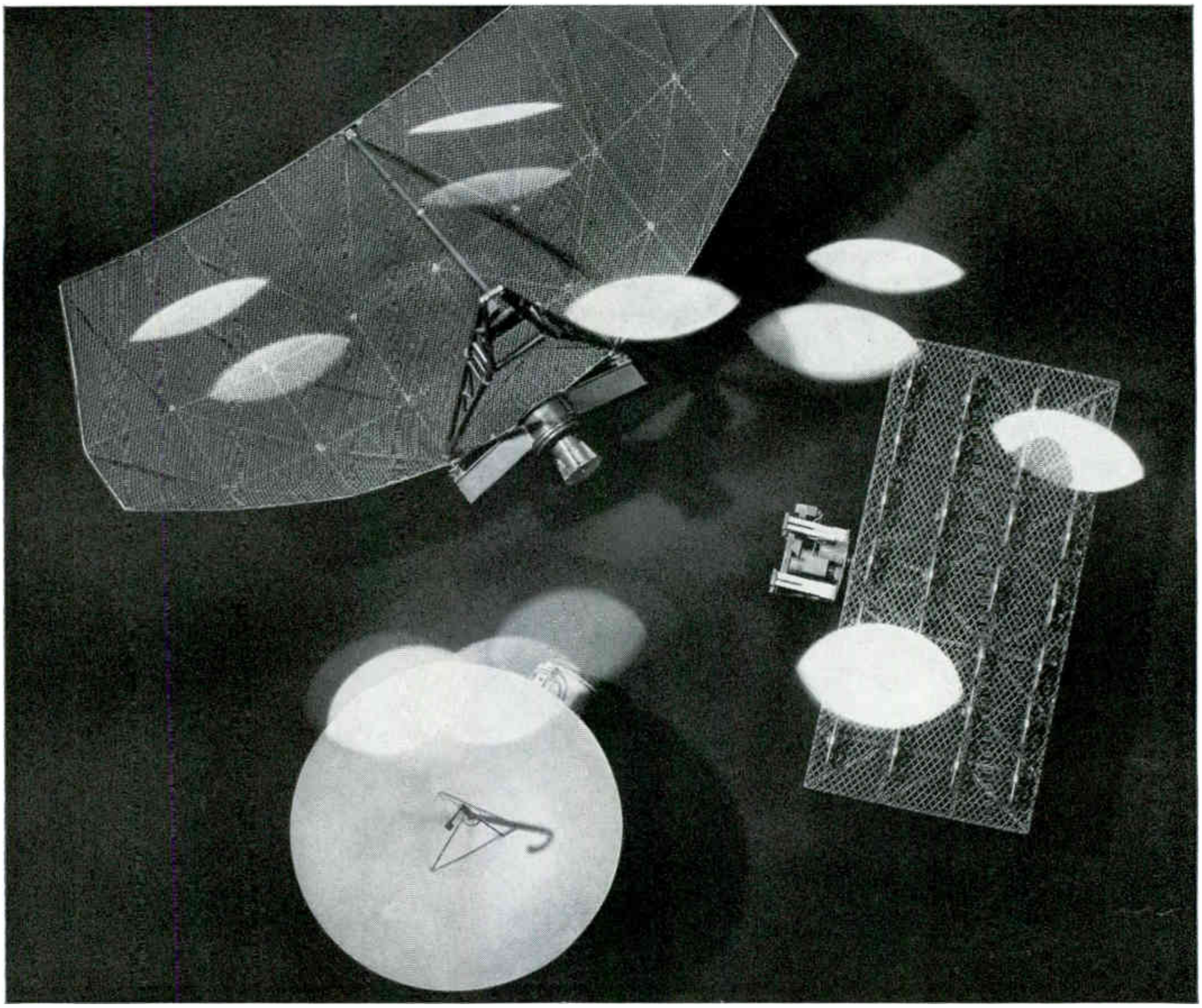
June 26-28: Military Electronics, National Convention, PGME of IRE; Shoreham Hotel, Wash., D. C.

Aug. 22-25: WESCON, L.A. & S.F. Sections of IRE, WCEMA; Cow Palace, San Francisco.

Sept. 11-15: Instrument-Automation Conf. and Exhibit, ISA; Sports Arena, Los Angeles.

Oct. 9-11: National Electronics Conf., IRE, AIEE, EIA, SMPTE; Int. Amphitheatre, Chicago.

Nov. 14-16: Northeast Research & Engineering Meeting, NEREM; Commonwealth Armory and Somerset Hotel, Boston.



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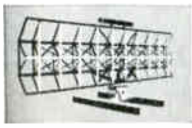
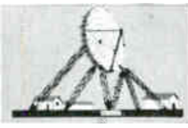
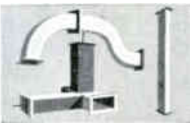


RADAR ANTENNA SYSTEMS



UHF ANTENNA SYSTEMS

PEDESTALS DRIVES • CONTROLS



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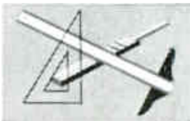

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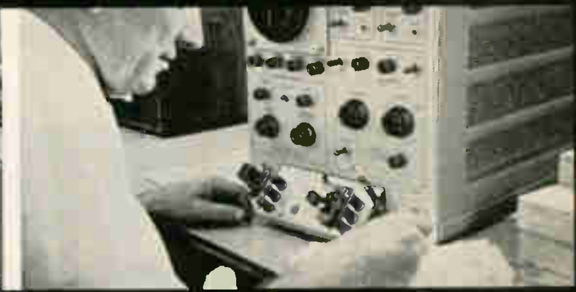

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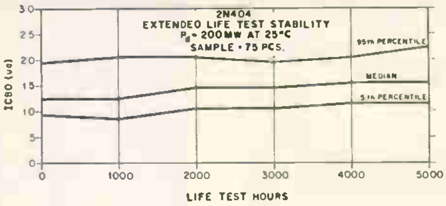
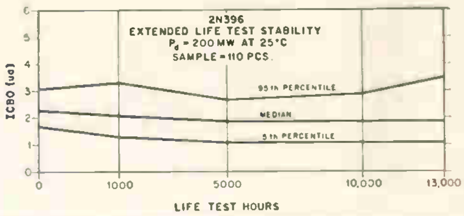
Thermal Shock	0/1400	0.0
Moisture Resistance	0/1400	0.0
Dew Point	0/950	0.0
Constant Accel. (5000G)	11/1614	0.68
Vibration Fatigue (10G)	4/1603	0.25
Lead Fatigue	0/1650	0.0
150 mw Life—1000 hrs.	10/2177	0.46
25°C Storage—1000 hrs.	0/1761	0.0
100°C Storage—1000 hrs.	0/1497	0.0



USN396A tested per MIL-S-19500/64A (Incoming-to-Warehouse)
Life Tests, Mechanical/Environmental Tests

Test	Failures	% Failures
Temperature Cycling	0/335	0.0
Moisture Resistance	0/235	0.0
Constant Accel. (5000G)	2/331	0.6
Vibration Fatigue (10G)	0/329	0.0
150 mw Life—1000 hrs.	0/435	0.0
100°C Storage—1000 hrs.	0/545	0.0



RATINGS AND CHARACTERISTICS (25°C)

TYPE NO.	COLLECTOR TO BASE CURRENT Max. I_{CBO} (μa)	@V_{CB} (volts)	COLLECTOR TO EMITTER VOLTAGE V_{CEO} (volts)	CURRENT GAIN h_{FE} Min.	Max.	SATURATION VOLTAGE V_{CE} (SAT.) Volts (Max.)	I_B	I_C	ALPHA CUTOFF f_{hfb} (mc) Min.	MAXIMUM DISSIPATION (mw)	MAXIMUM STORAGE TEMP. (°C)
2N394A	6	12	15‡	30	120	.15	1	10	5	150	100
2N396	6	20	20‡	30	150	.2	3.3	50	5	200	100
2N396A	6	20	20	30	150	.2	3.3	50	5	200	100
USN2N396A	6	20	20	30	150	.2	3.3	50	5	150	100
2N397	6	15	15‡	40	150	.2	2.5	50	10	200	100
2N404	5	12	24†	—	—	.2	1	24	4	150	100
2N404A	5	12	35†	—	—	.15	1	24	4	150	100
USAF2N404	5	12	24†	—	—	.2	1	24	4	120	85
2N414	5	12	15	60*	—	—	—	—	7*	150	85
2N427	4	1.5	15	40	80	—	—	—	5	150	100
2N428	4	1.5	12	60	—	—	—	—	10	150	100
2N1307	6	25	15†	60	300	.2	.17	10	10	150	100

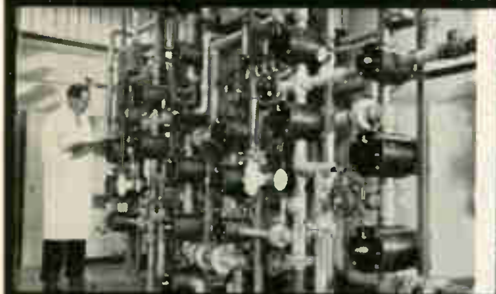
† Reach through voltage
‡ V_{CER}
* Typical

come from General Electric

The Scintiscaler is a super-sensitive Geiger counter which monitors Radiflo leak test units

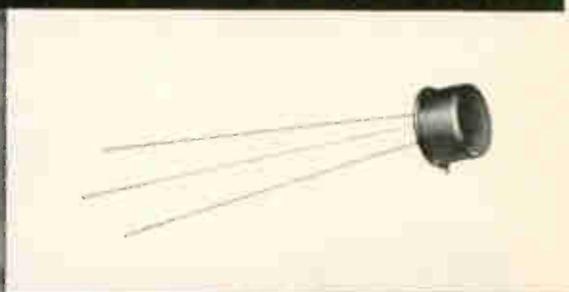
Drop-shock test

Acceleration-vibration test



All G-E transistors are washed in deionized water

Operating life test racks



G-E spec sheets give you the *complete* story of built-in performance. 2N404, for example, provides the most thorough characterization ever published. And *restrictive life testing* is your assurance of reliability and electrical stability. In addition to dozens of electrical and mechanical tests during production, every General Electric PNP high frequency transistor lot is subjected to a *minimum* of three separate *life* tests before warehouse acceptance, and then sampled again before shipment to you: operating at maximum rated dissipation, storage at maximum rated storage temperature, and room temperature storage. *All* operating life tests are performed under *maximum rated power conditions* with a duty cycle of 50 minutes "on" and 10 minutes "off."

For complete technical information and more of the impressive life test data on the 2N404, 2N396A, 2N428, or *any* of the types listed, call your G-E Semiconductor Products District Sales Manager, or write to Semiconductor Products Department, Section 25E97, General Electric Company, Electronics Park, Syracuse, New York. In Canada: Canadian General Electric, 189 Dufferin St., Toronto, Ont. Export: International General Electric, 150 E. 42nd St., N. Y. 17, N. Y.

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* The six-tenths of one-percent failure rate includes secondary failures caused by initial failures of one or more other components or external arcing.

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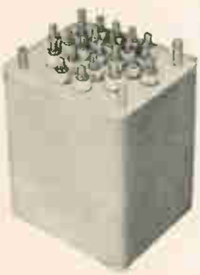

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315 Water Street **Cuba, N. Y.**
In Canada: Acme Electric Corp. Ltd., 50 Northline Rd., Toronto, Ontario

Acme ACME Electric

Application data on

counting tubes

and counting tube circuits

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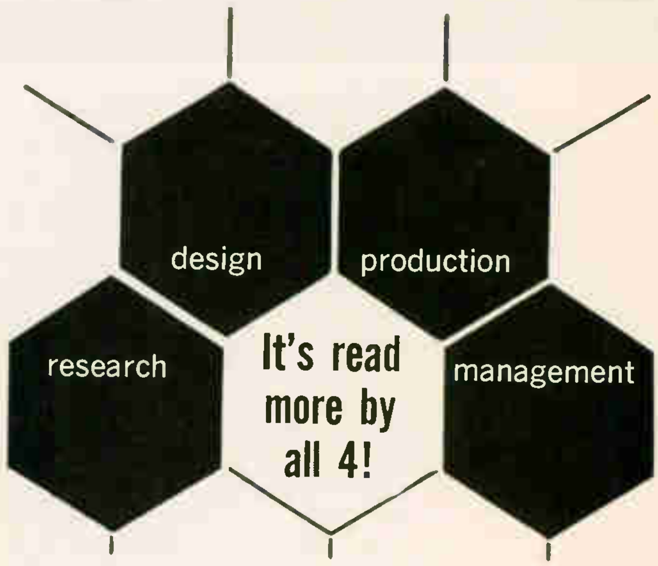

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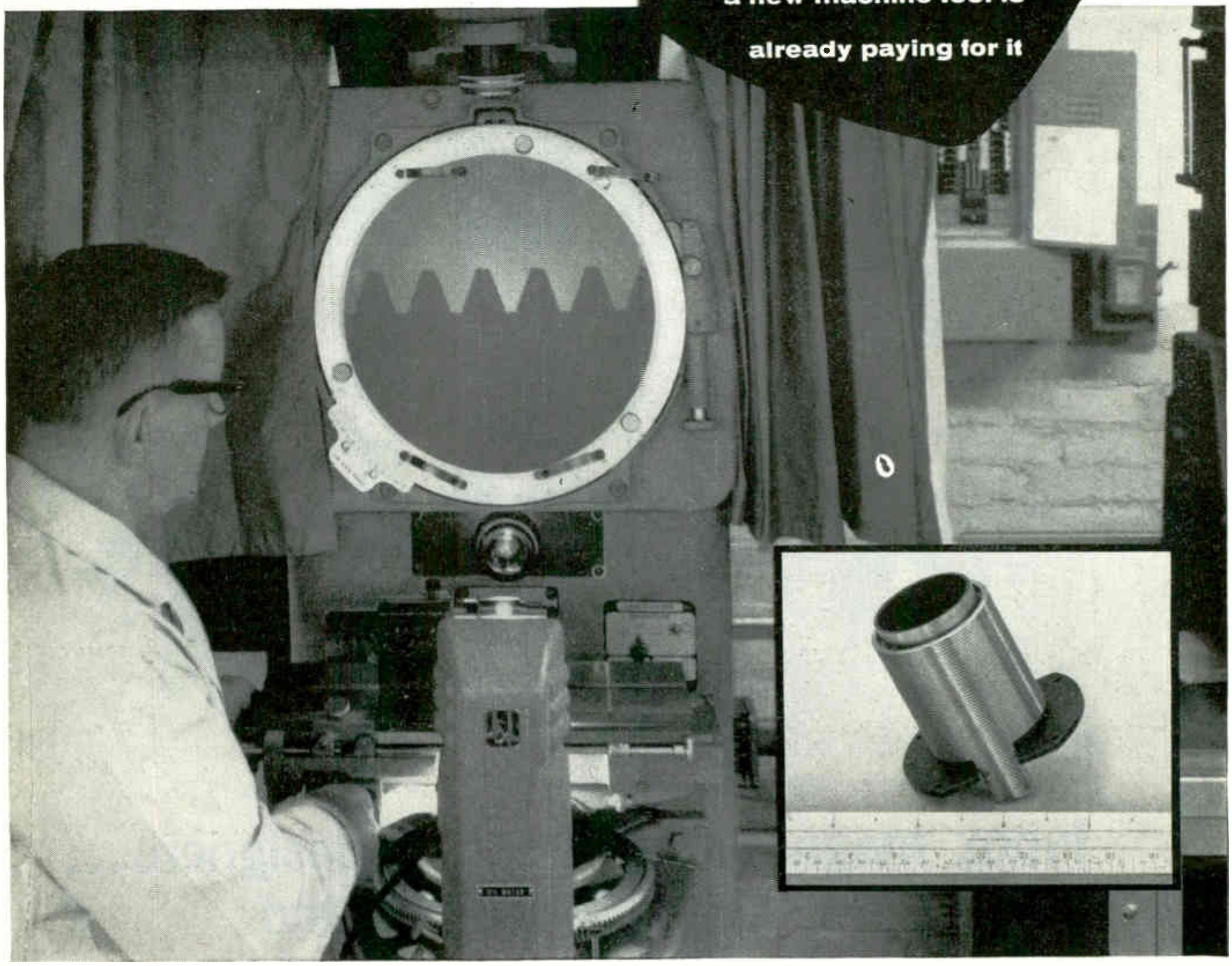
JONES & LAMSON OPTICAL COMPARATORS

the man who needs a new machine tool is already paying for it



Unretouched photo (above) shows this cylindrical rack being inspected at 62.25X. Photo, courtesy of Baird-Atomic Inc., Cambridge, Mass.

4000% Increase in Inspection Efficiency through use of a J & L Optical Comparator

Baird-Atomic, Inc., Cambridge, Mass., manufacturer of scientific and research instruments needed a rapid and precise method for the quality control measurement and inspection of various components. After experimentation with various types of inspection equipment, a J & L FC-14 Optical Comparator was given a trial. It met all requirements perfectly.

The inspection of a cylindrical rack, heart of the Baird-Atomic Periscopic Sextant, used in advanced aircraft, gives an illustration of the J & L Comparator's efficiency.

The rigid quality control tolerances for this part include: tooth-to-tooth tolerance, .0002″; tooth-to-tooth error, .0003″; composite error, .0003″; pitch dia. within .0005″; concentricity within .0005″ TIR.

Adequate inspection and measurement by conventional methods proved laborious and time-consuming: inspection rate was little better than one rack per day. Now, using a J & L FC-14 Optical Comparator, average inspection rate is 42 per day, an increase of approximately 4000%!

Investigate the possibilities of J & L Comparators in *your* production set-up. Available in 12 different models, both floor and table types.

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INDUCTANCE INCREASED TENFOLD IN NEWEST

JEFFERS

MINI-STAB INDUCTORS

MINIature-**STAB**le

NEW TYPES EXTEND MINI-STAB INDUCTANCE RANGE TO 10,000 MICROHENRIES!

Now, from Jeffers Electronics, pioneers in MINIature, STABle inductors, come the most recent additions to the line—MINI-STAB Inductors Types 2 and 3. Supplementing the Jeffers Type 101 and MINI-STAB Type 1 line, the two new miniatures increase the inductance values available from Jeffers to a range of 0.15 to 10,000 uh.

Miniaturization PLUS Stability

In Jeffers MINI-STAB inductors, *miniaturization* is achieved through more efficient use of coil winding space. *Stability* is made possible through the use of an open magnetic circuit as obtained with a conventional powdered iron coil form.

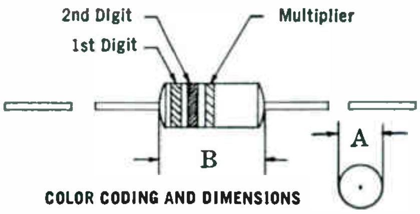
TYPICAL CHARACTERISTICS OF INDUCTOR DESIGNS BASED ON 1000 UH VALUE

INDUCTOR CHARACTERISTICS	JEFFERS MINI-STAB DESIGN	CONVENTIONAL DESIGNS	
		MINIATURIZED*	NON-MINIATURIZED
Miniaturization (wt. in grams)	1.0	0.5 to 2	2 to 10
Stability of Inductance with temp. −55 to +125°C	±2%	±10%	±2%
with applied current (zero to 90 MA)	−1%	−30%	NIL
with applied voltage (test or signal)	GOOD	POOR	GOOD

*Utilizing closed magnetic circuits such as toroids, cup-cores, etc.

A comparison of typical MINI-STAB performance with that of conventional miniaturized and non-miniaturized inductors appears above. Inductor designs of the closed magnetic circuit type such as toroids, cup cores, etc. tend to be inherently unstable.

THIS IS THE EXPANDED MINI-STAB LINE



COLOR CODING AND DIMENSIONS

TYPE	A±.015	B±.015	LEADS
1	.190	.440	AWG. #22 1⁵⁄₁₆ Min. Length
2	.220	.600	AWG. #21 1⁵⁄₁₆ Min. Length
3	.240	.740	AWG. #20 1⁵⁄₁₆ Min. Length

MINI-STAB TYPE 1

PART NUMBER	TYPE	INDUCTANCE (Microhenries)	MEAS. FREQ. (MC)	Q MIN.	SRF MIN. (MC)	D.C. RES. MAX. at 25°C (OHMS)	CURRENT* RATING (MA)	COLOR-CODING		
								1st	2nd	3rd
1311-1	1	18 ± 10%	2.5	50	25	1.8	315	BRN	GRY	BLK
1311-2	1	22 ± 10%	2.5	50	24	2.0	300	RED	RED	BLK
1311-3	1	27 ± 10%	2.5	50	20	2.8	255	RED	VLT	BLK
1321-1	1	33 ± 10%	2.5	50	19	2.5	270	ORG	ORG	BLK
1321-2	1	39 ± 10%	2.5	50	18	3.0	245	ORG	WHT	BLK
1321-3	1	47 ± 10%	2.5	50	17	3.5	225	YEL	VLT	BLK
1321-4	1	56 ± 10%	2.5	50	15	4.2	205	GRN	BLU	BLK
1321-5	1	68 ± 10%	2.5	50	14	5.0	190	BLU	GRY	BLK
1321-6	1	82 ± 10%	2.5	50	12	5.5	180	GRY	RED	BLK
1321-7	1	100 ± 10%	2.5	50	11	6.0	170	BRN	BLK	BRN
1321-8	1	120 ± 10%	0.79	50	9.0	7.0	160	BRN	RED	BRN
1321-9	1	150 ± 10%	0.79	50	8.6	8.0	150	BRN	GRN	BRN
1321-10	1	180 ± 10%	0.79	50	8.0	9.0	140	BRN	GRY	BRN
1321-11	1	220 ± 10%	0.79	50	6.6	10.0	130	RED	RED	BRN
1331-1	1	270 ± 10%	0.79	45	4.0	6.8	165	RED	VLT	BRN
1331-2	1	330 ± 10%	0.79	45	3.6	7.4	155	ORG	ORG	BRN
1331-3	1	390 ± 10%	0.79	45	3.4	10.6	130	ORG	WHT	BRN
1331-4	1	470 ± 10%	0.79	45	3.1	11.5	125	YEL	VLT	BRN
1331-5	1	560 ± 10%	0.79	55	2.9	15.2	110	GRN	BLU	BRN
1331-6	1	680 ± 10%	0.79	50	2.6	17.0	105	BLU	GRY	BRN
1331-7	1	820 ± 10%	0.79	50	2.4	19.0	100	GRY	RED	BRN
1331-8	1	1000 ± 10%	0.79	45	2.2	21.3	90	BRN	BLK	RED
NEWEST MINI-STAB TYPES 2 AND 3										
1312-1	2	1200 ± 10%	.25	60	2.2	21.0	110	BRN	RED	RED
1312-2	2	1500 ± 10%	.25	60	2.1	24.0	105	BRN	GRN	RED
1312-3	2	1800 ± 10%	.25	65	1.9	27.0	100	BRN	GRY	RED
1312-4	2	2200 ± 10%	.25	70	1.7	30.0	95	RED	RED	RED
1312-5	2	2700 ± 10%	.25	70	1.6	33.0	90	RED	VLT	RED
1312-6	2	3300 ± 10%	.25	70	1.4	37.0	85	ORG	ORG	RED
1313-1	3	3900 ± 10%	.25	75	1.5	44.0	90	ORG	WHT	RED
1313-2	3	4700 ± 10%	.25	80	1.4	49.0	85	YEL	VLT	RED
1313-3	3	5600 ± 10%	.25	80	1.2	54.0	80	GRN	BLU	RED
1313-4	3	6800 ± 10%	.25	80	1.1	60.0	75	BLU	GRY	RED
1313-5	3	8200 ± 10%	.25	80	1.0	67.0	70	GRY	RED	RED
1313-6	3	10000 ± 10%	.25	80	0.9	75.0	70	BRN	BLK	ORG

*Based on a 25° C Maximum Temperature Rise.

MINI-STAB inductors are capable of meeting the requirements of MIL-C-15305, Grade 1, Class B, as outlined in Jeffers Product Specification SK-393. Details are available on request.

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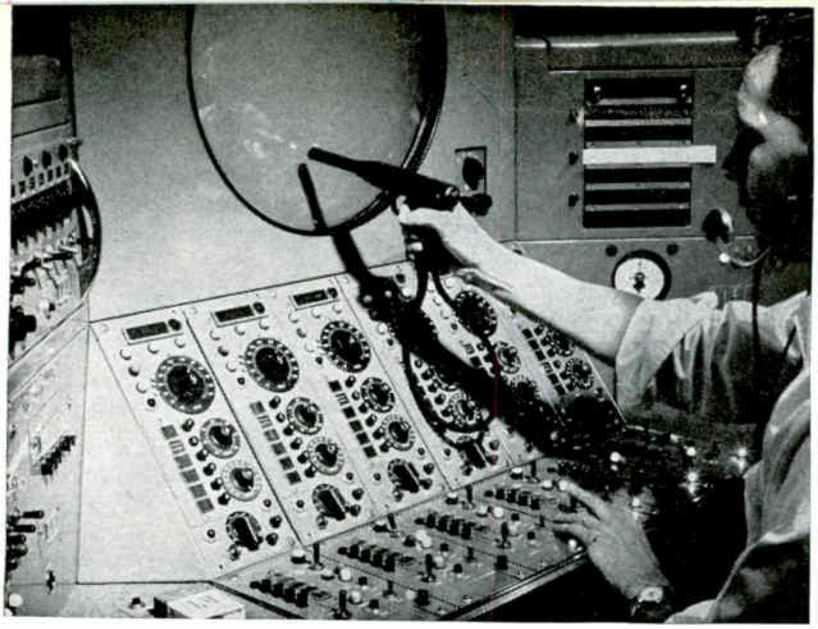


electronics
May 26, 1961

In the AN/GSN-11 control system, initial communication with arriving aircraft is handled through traffic console. Aircraft radar returns are acquired for tracking channels with light-gun

Air-Traffic Terminal Controller Computes and Sends Instructions

Ground-based air traffic control system simultaneously governs 18 arrivals and six departures, depends on radar surveillance

By R. MEULEMAN
S. D. MOXLEY, JR.,
AVCO Corp., Electronics and Ordnance Div., Cincinnati, Ohio

A CRUCIAL problem in air traffic control occurs in the terminal area, a radius of 60 to 90 miles surrounding every high-density airport. Faced with efficient handling of jet and prop traffic in their return-to-base operations, the U. S. Air Force has for three years sponsored the development of the terminal area control system described in this article. This system, designated AN/GSN-11 air traffic control central (formerly Volscan) is based on controlled arrival scheduling, a gradually tightening computer-pilot control loop, and a technique for automatic ground-air voice communications. The overall system, which includes six consoles and 50 cabinets, is scheduled for life flight testing at FAA's Atlantic City test center this summer.

The AN/GSN-11 is a ground-based electronic traffic control system that simultaneously controls 18 arriving aircraft and six departures in a terminal area. Each arriving aircraft is assigned an individual tracking-computing channel that schedules a precise touchdown time and closely controls the aircraft. Automatic approach-control instructions computed by the AN/GSN-11 are dependent on the continuously moving position of the aircraft, determined by a surveillance radar.

To achieve the precision necessary for safe positive separation while increasing traffic rate to the theoretical maximum, the AN/GSN-11 encloses each aircraft in a close-control vectoring loop (Fig. 1A). Aircraft position provided by the radar is supplied to the flight path computer by automatic target tracking equipment. On the basis of aircraft flight characteristics supplied from the traffic console during initial acquisition, the computer compares the aircraft's present position with its scheduled arrival and determines vector headings and descent instructions to achieve the desired touchdown timing. Computer orders in the form of relay closures and numerical encoding are automatically translated into voice instructions radioed to the pilot. The pilot's conformance to instructions is detected by the radar closing the loop.

The rate at which aircraft can be landed at an airport is dependent on the precision with which arrival times can be controlled. Separation standards in use reflect presently achievable precision. In manual radar approach control, an aircraft can be vectored to arrive at touchdown within ±30 seconds of the desired instant. Among the many factors preventing a tighter delivery precision are wind drift, communications time delays, pilot and aircraft reaction time, heading and speed errors. Even so, the precision of manual radar delivery is far superior to that possible with timed approaches used previously, and still resorted to during radar outages.

Critical to the achievement of higher acceptance rates is the problem of common-path overtake. When a fast aircraft follows a slow one, enough additional separation must be allowed as the fast aircraft comes onto final approach so that it does not violate safe separation from the slower aircraft preceding it.

To achieve a delivery precision of ±9 seconds, the GSN-11 uses long-range scheduling followed by gradually tightening closed-loop vectoring. Communication delays are drastically reduced by the automatic voice equipment. To compensate for reaction time and instruction-following errors, the control loop enclosing each aircraft continuously modifies its command maneuver while the maneuver is still in progress.

An aircraft reaching the terminal area (Fig. 1B) is assigned an initial schedule which, because of conflict with previously scheduled aircraft, requires that the aircraft delay its arrival 180 seconds beyond the earliest time it could touch down. As the aircraft is placed under automatic-voice control, the pilot receives an initial

---

FLIGHT PATH COMPUTATIONS

Refer to approach geometry (Fig. 3A) and computer block diagram (Fig. 4). All computations occur simultaneously.

DISTANCE

r	*radar-to-aircraft range*
θ	*radar-to-aircraft azimuth*
$X'' = r \sin\theta - X_e \pm X_o - X_w$	*rectilinear coordinates from center of*
$Y'' = r \cos\theta - Y_e \pm Y_o - Y_w$	*turn-on-circle to aircraft*

where X_e, Y_e are radar to entry point offsets, Y_o is turn-on-point to entry-point offset, X_o is diameter of turn-on circle, X_w, Y_w are wind-drift entry point offsets

$\theta'' = \arctan X''/Y''$	*aircraft bearing from circle-center*
$r'' = \sqrt{X''^2 + Y''^2}$	*aircraft range from circle-center*
θ', r' (*computation not shown*)	*aircraft range and bearing from turn-on point*
$\alpha = \arcsin \left\lvert \frac{X_o}{r''} \right\rvert \; (0° < \alpha < 90°)$	*aircraft circle-center-to-tangent angle*
$d = d_t + d_a + \lvert Y_o \rvert$	*direct-flight distance to entry point*
$= r' + \lvert Y_o \rvert \; (165° < \theta' < 195°)$	*(inside stability cone)*
where $d_t = r'' \cos\alpha$	*is straight flight to tangency*
and $d_a = \frac{2\pi X_o (180° - \theta'' + \alpha)}{360°}$	*is distance around circle*

PREDICTED AVERAGE VELOCITY

$V_{Tai} = V_i \left(\frac{A_i}{45{,}000} K_d \pm K_t \right)$	*ground speed at initial altitude*

where V_i is "indicated air speed" flown by aircraft, A_i is initial altitude of aircraft, K_t is base-leveling air temperature constant (adjustable ± 0.4), K_d is air-density constant (adjustable between 1.2 and 2.8 for 45,000 ft)

$V_C = V_{Tai} - \frac{(V_{Tai} - V_i)}{2} \frac{A_i}{H^*},\ H^* > A_i$	*average velocity to the entry point (before begin descent)*
$= \frac{(V_{Tai} - V_i)\,H}{2A_i} + V_i,\ H < A_i$	*(after begin descent)*

where H^* is ficticious computational altitude (see Fig. 3B)

TIME

$t_f = L/V_f$	*time on final glide-slope L*
$t_M = \frac{2M}{V_i + V_f}$	*time slowing down on level-out M*
where V_f is final-approach speed	
$t_c = d/V_c$	*time from present aircraft position to entry point*
$t_d = t_c + t_m + t_f$	*direct-path flight time from present aircraft position to touchdown*
$t_s = t_a + t_m + t_f$	*scheduled time to touchdown*
(t_a is, therefore, scheduled time to entry point)	
$E = t_a - t_c$	*error between scheduled arrival time and direct-path flight time*

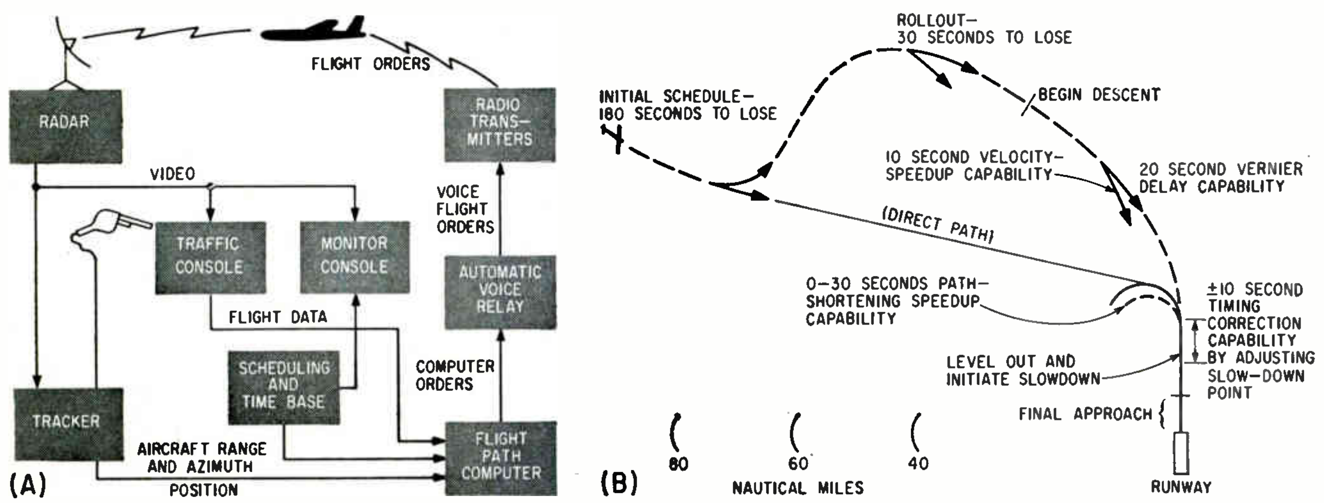


FIG. 1—Precise control of air traffic is achieved with this control loop (A). Homing-in action of computer-pilot control loop (B)

(E is minus for aircraft ahead of schedule, plus for late arrival)

ALTITUDE

$H = Rt_a + h_e$ — *scheduled altitude*

where h_e is level-out altitude, R is rate of descent

(Note from Fig. 3B that computational H can extend beyond A_i during initial level portion of flight, and that begin-descent occurs when H gets down to A_i.)

$R = R_s V_i / V_s$ — *rate of descent, standard or nonstd, for glide slope*

where R_s is standard rate-of-descent for standard glide slope, V_s is standard indicated velocity for standard glide slope

NO PASS ZONE

$H_n = n \frac{R_s}{V_s}$ — *altitude at no-pass zone boundary for glide slope*

$t_n = t_a - \frac{H_n}{R}$ — *scheduled time from aircraft position to no-pass-zone boundary*

CHANGE VELOCITY

$\Delta V = V_i (t_e/t_a - 1)$ — *velocity change which, executed over remaining direct-path flight to entry point, would result in arrival at scheduled time*

HEADINGS AND PATH-STRETCHING

$B = K_B \arccos (1\text{-}E/100 \text{ sec})$ — *heading offset from direct-path to entry point which delays aircraft at desired rate*

where K_B is gain of path-stretching function

u = *runway heading offset from due south*

$\phi = \theta'' - 180° \pm \alpha \pm B + u$ — *aircraft command heading*

(plus for left circle, minus for right circle)

$\phi = \theta' - 180° \pm B + u$ — *when aircraft is in stability cone (within ±15 deg of lineup)*

$\phi = \theta'' - 180° \pm \alpha + u \pm$ *dogleg offset* — *in initial offset heading for dogleg pattern*

$\phi = \theta'' - 180° \pm \alpha \pm B + u \pm A$ — *in turn-circle anticipation zone*

where $A = K_A V_C$ — *turn anticipation offset*

and K_A *adjustable* — *3 deg-16 deg per 100 knots*

$\phi = \theta' - 180° - K_1 X'$ — *final lineup pursuit lead heading*

where K_1 is pursuit lead constant set at around 2 miles

WIND DRIFT

$$X_w = \frac{\Delta H_1 W_{x1} + \Delta H_2 W_{x2} + - - \Delta H_5 W_{x5}}{R}$$ *wind shift of entry point for wind drift*

$$Y_w = \frac{\Delta H_1 W_{Y1} + \Delta H_2 W_{Y2} + - - \Delta H_5 W_{Y5}}{R}$$

(As aircraft descends, ΔH_1, then ΔH_2 etc., gradually drop out of the computation and the wind-shifted entry-point gradually drifts back to the geographical entry point.)

SLOW DOWN

initiate at $| Y_o | + K_s E = 0$

where K_s is slow-down shift-constant, set at about 10 sec per mile

offset heading to accomplish most of this delay. However, the aircraft is rolled onto an approximately radial course when it is still 30 seconds early.

At a calculated point, the aircraft is instructed to begin a single continuous descent from initial to final-approach altitude, and is given this instruction at the time to allow reaching traffic altitude with just time for slow-down and final-approach.

As the aircraft comes closer to the airport, its schedule delay is gradually taken out by a slightly curved approach path. As the aircraft nears the turn-on circles, automatic voice message priorities are increased, enhancing precision with which the aircraft is controlled, and tightening control-loop response.

At level-out altitude a last timing correction is invoked by adjusting the point at which the aircraft is commanded to slow down for final approach. Should the particular approach involve a long turn around the turn-circle, additional schedule control is achieved by moving the turn circle to which the aircraft is directed.

As aircraft level out on runway lineup, they are transferred to an instrument-landing (ILS) or ground-control (GCA) system, interleaved not only to prevent overtake on final approach, but spaced to achieve a timing precision of ±9 seconds at touchdown.

For maintaining continuous target identities for the human controllers, and to continuously inform the flight plan computers of the position of each aircraft under control, the GSN-11 includes video equipment capable of simultaneously tracking 24 aircraft. Once an aircraft's radar return on the ppi scope is acquired by the controller's light-gun, a rectangle of light appears surrounding the target and follows it across the scope. An identifying symbol is also carried by the tracking gate, successively painting alphanumeric identity near each target.

Initial communication with an arriving aircraft is handled

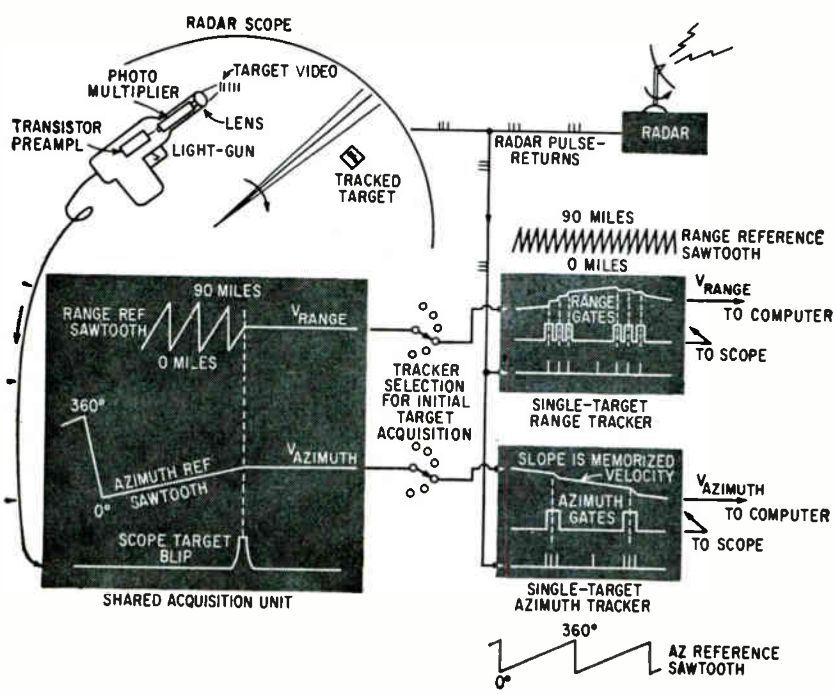


FIG. 2—In radar target acquisition and tracking, references for scaling position of target in range and azimuth are two sawtooth voltages

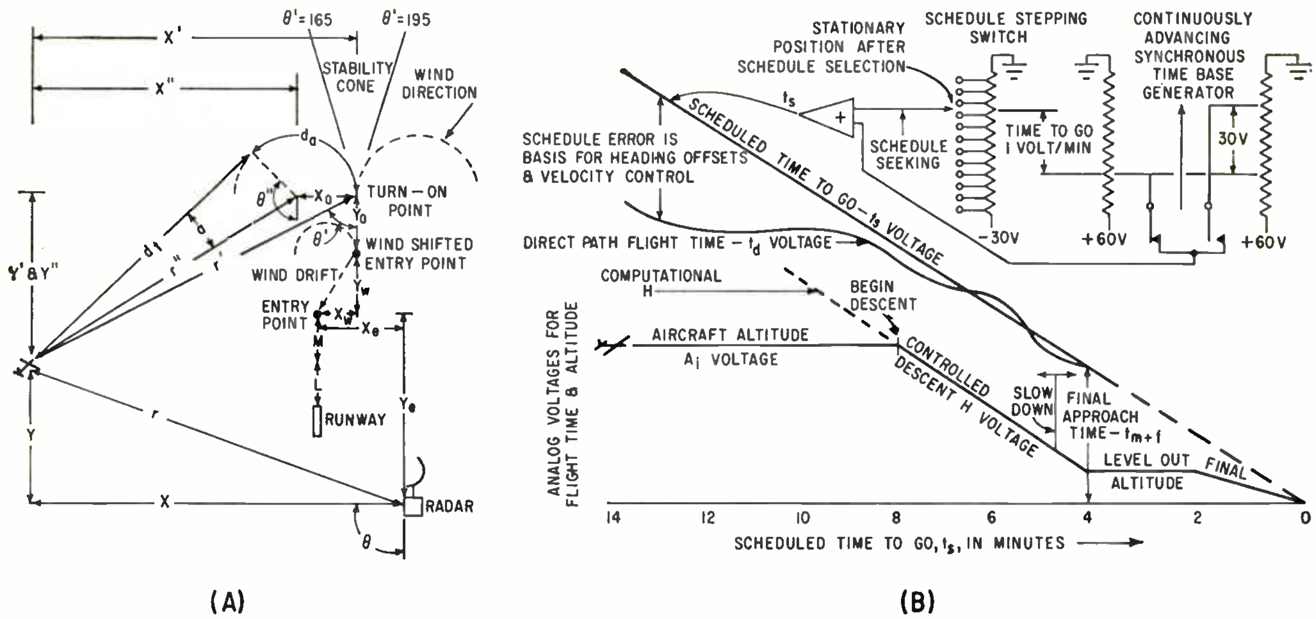


FIG. 3—Arrival geometry (A), and schedule stepping switch (B) that sequentially samples future landing intervals and logically selects arrival time

through the traffic console (see photo). The controller selects the type of video (beacon, normal, MTI) for best target return and points his light-gun toward the blip of light representing the aircraft. With his left hand, he selects the unused tracking-channel to be assigned.

The references for scaling position of a tracked target in range and azimuth are two sawtooth voltages (Fig. 2). An azimuth sawtooth in synchronism with the radar antenna represents azimuth position at the scale of 100 volts for 360 degrees. A range sawtooth in synchronism with the pulse-repetition-frequency represents at any instant after each main bang the instantaneous range of an arriving reflection at the scale of 1 volt per mile.

When acquiring a target for automatic tracking, a blip of light representing one strobe of the radar target reaches the lens system and multiplier phototube of the light gun (Fig. 2) at the instant during which the synchronized range and azimuth sawtooth voltages represent the true position of the aircraft. The amplified target pulse from the light gun clamps range and azimuth sawtooth voltages at these values in the acquisition unit. When acquiring a target, the specific tracking channel to be assigned to this new aircraft is connected to the acquisition unit so that the clamped output voltages initially slew the range and azimuth sections of the target tracker.

Thereafter, the range-azimuth gates generated by the tracker allow only radar video in close proximity to the slewed position to enter the memory circuits. These same gates point the rectangle of light at half-brilliance on the radar screen, forming the tracking gate which surrounds the target video.

On each successive sweep of the radar, the range and azimuth gates recenter on the target video gated into the memory circuits. Amount of position change between antenna rotations forms a velocity voltage in the memory, which thereafter causes continuous extrapolation of gate position between sweeps. If the velocity extrapolation is perfect, the tracking gate is recentered when, on the next antenna sweep, target video reappears.

If target video fades one antenna rotation, the tracking gate coasts on, so as to be centered at the next sweep. If video is absent for three rotations, the tracking gate automatically widens to at least twice normal size to recapture the lost target. While tracking gate size is adjustable, a typical narrow-gate dimension is 1 mile by 3 degrees.

Based on the arrival geometry (Fig. 3A) and rate of descent glide slopes, the flight plan computer derives shortest flight time from the aircraft's present position to touchdown. Since other arrivals are already scheduled, however, the new aircraft's time must be compared with the others before it is assigned a schedule.

Stepping out from present time, the new aircraft's schedule stepping switch (Fig. 3B) sequentially samples future landing intervals until a logical selection is made that allows minimum time for arrival and does not conflict with other arrivals. The stepping switch remains stationary for the rest of the flight, establishing a voltage difference with the continuously advancing synchronous time-base generator, which difference is representative of t_s, the scheduled time to go.

As the time-base generator advances, t_s linearly declines (Fig. 3B). The direct path flight time, t_d, is always less than t_s at beginning of the schedule, and the difference, schedule error, is proportional to time the aircraft must be delayed. The computer develops a heading offset from the most direct path, and diverts the aircraft until the delay is accomplished. As the flight progresses, t_d homes-in on t_s delivering the aircraft at level-out with proper timing and slow-down control to extrapolate its delivery at the runway close to the correct instant.

On basis of scheduled time-to-go and programmed rate-of-descent, the computer also commands the aircraft to begin descent, thereafter reads altitude check-points as the aircraft descends.

When the time-base generator reaches the same voltage as that on the stepping switch, the aircraft should be touching down and the schedule is dropped. Thereafter the unscheduled channel stepping switch steps regularly to keep in synchronism with the main time-base generator. For a new schedule it again steps away into voltages representing future time.

To provide a continuous time-base from discontinuous potentiometers, the time-base generator consists of two potentiometers with wipers 180 degrees opposed. Whenever a schedule stepping switch crosses from 0 to −30 volts in its seeking process, its time-base reference switches to the alternate potentiometer.

Identical electromechanical analog computers control each of 18 inbound aircraft. Electromechanical analog is used because of its simplicity, reliability and advantages in solving simultaneous trigonometric equations. To take cognizance of an aircraft's present position, to compare it with a preselected arrival schedule, and to determine control instructions to be radioed by the autovoice synthesizer, a simultaneous solution to a variety of geometrical offset, altitude, timing and path-stretching calculations must be made.

Fixed parameters of the local landing pattern (n, l, m, K_d, K_t, Y_e, Y_o, X_e, X_o, Fig. 4) are part of the permanent computer memory. Others (A_i, V_i, V_f, glide slope) are inserted by the controller for the particular aircraft to be controlled, while the dynamic independent variables r, θ, and t, are entered by the machine. A simplified list of flight path computations is shown in the editorial box.

Significant in relieving controller work-load and achieving tight vectoring control is the ability of the GSN-11 computer to talk directly to the pilot. This is done through the automatic voice relay unit, wherein the computer by relay closures and encoders selects a combination of prerecorded voice phrases. An automatic voice unit transmits messages selected from a magnetic drum with 200 playback heads and identical preamplifiers. Divided into nonoverlapping time sectors over each 2.5-second revolution, the prerecorded phrases enable the composition of a complete message by paralleling a combination of channels. While the words or phrases on all 200 channels are simultaneously spoken through the preamps every drum rotation, the message selector relays during any revolution connect the transmitter to only those words making up the proper message. Message length is either 2.5 or 5 seconds. For the 2-revolution, 5-second messages, the two separate channel combinations are independently assembled and alternately gated during the two successive rotations.

The same radio frequency transmits automatic voice messages to as many as three different aircraft. Each message is preceded by an identifier such as "bluebird", "cardinal", identifying the aircraft addressed. A priority order of transmission is established between messages of differing importance. For instance, if one flight plan computer requests an emergency turn for "bluebird" simultaneously with request for the routine altitude check-point message for "cardinal angels ten", the auto voice unit automatically transmits the emergency-turn message first, it being of higher priority. If, after this 5-second delay, programmed altitude for "cardinal" is still within 200 feet of "angles ten" (10,000 feet) this less important 2.5-second message will be transmitted. The automatic voice has a vocabulary of 25 different message types, with almost unlimited numerical combinations therewith. An interchangeable priority order is established between message types.

By auto-voice the ground-to-air communications time-constant of the close control vectoring loop is held to the minimum achievable with voice communications. In a 5-second heading transmission such as "bluebird heading—275", the second-revolution numbers are not frozen until the beginning of the second revolution. Therefore, a command heading is only two seconds out of date with the computer at the instant it is spoken.

Other advantages include uniformity of message intonation and accent, and the possibility of handling a foreign language. For reliability, two identical 200-channel drums are equipped with automatic switch-over in the event of malfunction, and the message-forming circuit includes extensive malfunction-detection provisions.

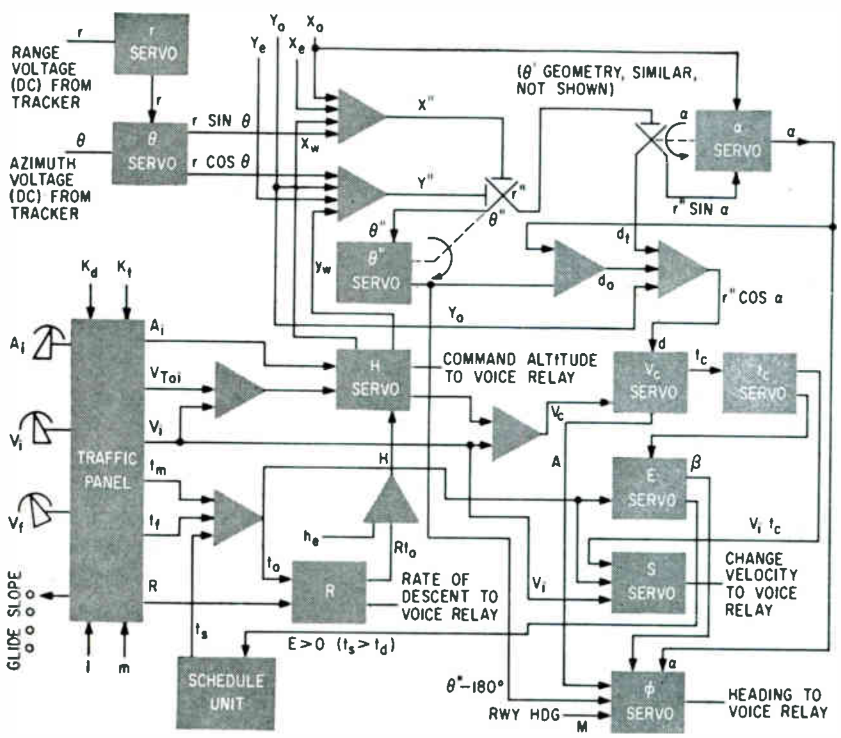


FIG. 4—Flight plan computer. Certain parameters of local landing pattern are part of the permanent computer memory.

Gas-Filled Ultraviolet Detector

Detector tube that exhibits a power gain of 110 db enables

By D. H. HOWLING*
R. C. ROXBERRY*,
McGraw-Edison Co., West Orange, N. J.

RELIABLE ULTRAVIOLET radiation detector tubes have numerous applications in systems where uv radiation is the independent variable. Typical applications include fire detection, explosion detection and communication systems. A recently developed ultraviolet detector tube that features stable high-power gain and sensitivity in the spectral region of 1,900-2,900 A exhibits a peak response at 2,200 A. The tube (Fig. 1A) consists of two symmetrical electrodes of special construction and material enclosed in a gas-filled uv-transmitting glass envelope. Electrode symmetry permits operation on a-c or d-c. Using an a-c supply, the electrodes interchange as anode and cathode on alternate half-cycles. Because of the natural gas-discharge quenching aspects of the a-c supply, the full gain inherent in gas amplification devices has been made available as power gain.

Figure 1B illustrates the voltage waveforms for a saturated signal (see circuit of Fig. 2A). Arrival of a sufficient quantity of incident ultraviolet photons at the cathode results in the emission of an electron. If the voltage impressed between the electrodes is above the voltage breakdown level of the filling gas, this electron is accelerated to ionization energy and produces breakdown of the gaseous interspace. This is the conduction phase of the tube. The tube remains fully conducting until the supply voltage drops below the discharge sustaining voltage V_Q. During the next half cycle of operation the process is repeated.

Average tube power during conduction is limited primarily by the tube's thermal characteristics. However, the tube design permits its use in ambient temperatures of as high as 200 C. The tube can be used in a pulsed power mode if the on-off duty cycle ratio is kept within reasonable limits.

Average tube power output is I^2R where I is the rms tube current through the series tube load R. Current I is a maximum at tube saturation. A tube is saturated when every half cycle is a conduction cycle. At saturation, any further increases in radiant flux will not substantially increase tube current; thus, under saturated conditions, power output per pulse is constant.

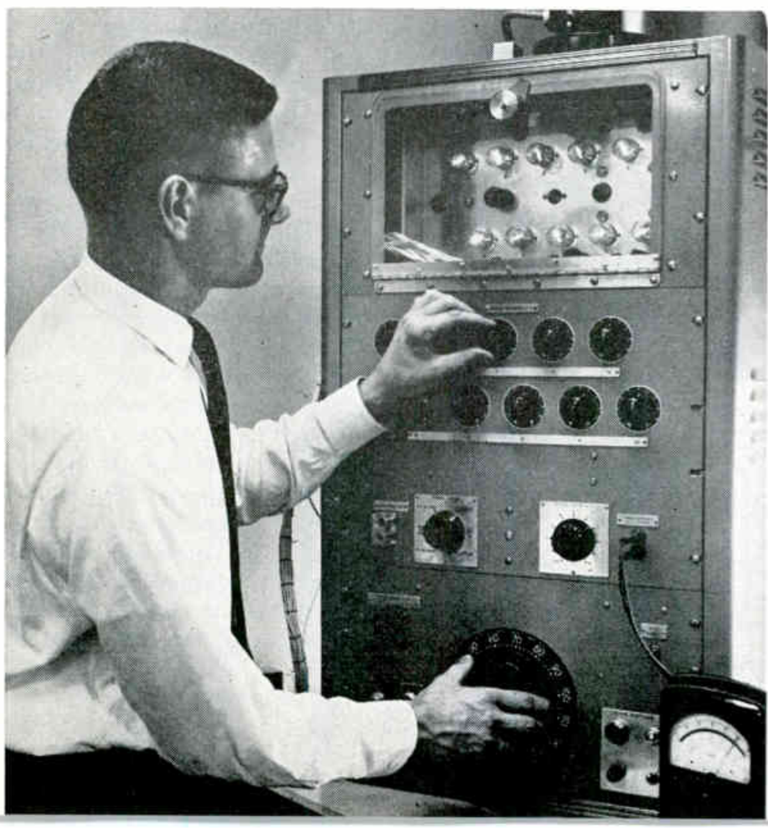
Another useful tube parameter is current sensitivity S, where $S = I/A\phi_o = I/\phi$. Here A is the area in sq cm of a single electrode acting as cathode, ϕ_o is the average incident radiant flux density in watts/sq cm directed at the electrodes and measured at the tube envelope, and $\phi = \phi_o A$ watts. A typical value of S at 60 cps operating frequency is 2.3 $\times$ 10^8 amp per watt.

The noise level of the uv tube is dependent on its environment. A minimum average noise level is approximately 0.2 count per minute. This minimum exists when the tube (at sea level) is in a darkened area, and is due to cosmic radiation. Ultraviolet radiations of wavelengths longer than 2,900 A will not increase this noise level. An overhead sun (tube at sea level) will raise this noise level to approximately 10 counts a minute due to penetration of the earth's atmosphere by solar radiation shorter than 2,900 A.

Any radiating source containing ultraviolet in the wavelengths 1,900 A to 2,900 A can power the tube. A standard calibrating source is a propane flame 1¾ inches high. This standard flame is also approximated by a ¾-inch diameter candle. The flame source is placed 12 inches from the plane of the electrodes. These conditions describe the standard signal—herein called C 12—as received at the tube.

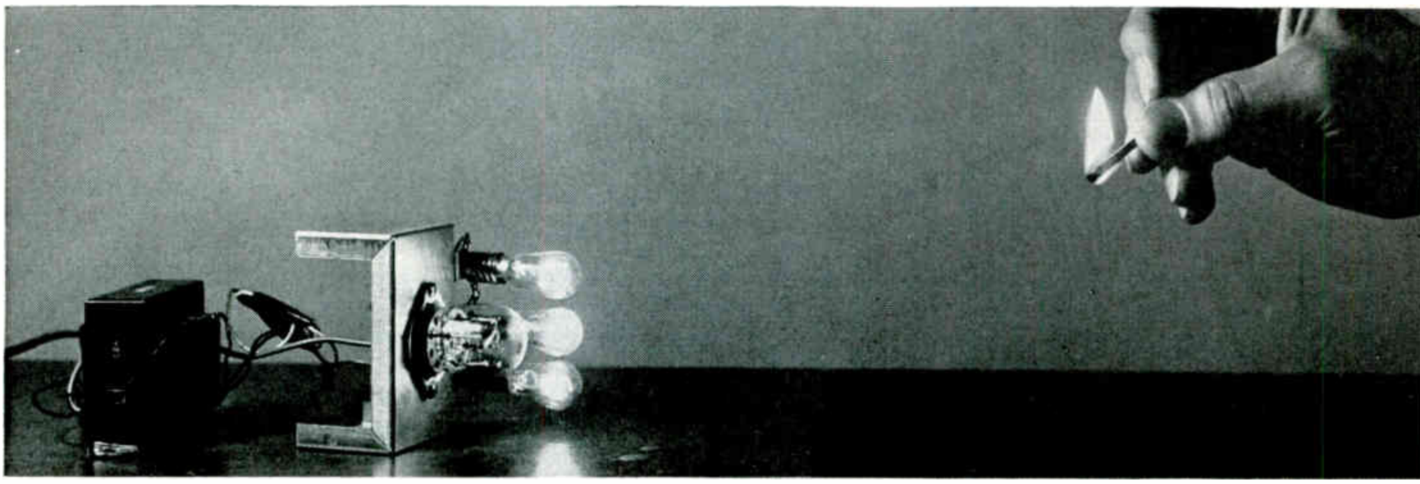
* Now with American Standard Research Division, Union, N. J.

One of the authors adjusts voltage and load levels on detectors in aging rack



Warns of Fires and Explosions

rapid counting of ultraviolet radiation in many applications



Output of tube which has been triggered by uv in match flame is enough to energize three incandescent lamps

Present tubes are normally operated at 700 volts rms. Instantaneous striking voltage V_f is approximately 700 v. Self-counting is not exhibited below a supply voltage of 2 V_f (1,400 v). Relation of count rate to applied voltage is shown in Fig. 2B.

Maximum conduction time β (Fig. 1B), using a sine wave supply, is approximately 63 percent (or 114 deg) of every half cycle. If the tube conducts the maximum rated 25 ma average current (limited by a typical 10,000-ohm load), the average tube power dissipation is approximated by P = 330 v × 0.63 × 0.025 amp = 5.2 w. The average power dissipated in the 10,000 ohm resistive load is $P_L = I^2R = (0.025)^2\ 10^4 = 6.25$ w. The db power gain of the tube is $G = 10 \log (P_L/P_{in})$ where $P_{in} = 8 \times 10^{-11}$ watts, the total received radiant flux measured with a spectrophotometer at the tube envelope at 2,200 A.

Hence $G = 10 \log (6.25/8 \times 10^{-11}) = 109$ db. Coupling the tube to practical circuits usually precludes taking complete advantage of the available power gain.

Typical tube power gain curves for two operating supply frequencies with resistive load are shown in Fig. 2A. An example of a radiant source capable of saturating the tube is a candle located 3 to 4 inches from the tube. Only 1 part in 10^6 of the radiant flux from the candle is within the passband of the detector (1,900 – 2,900 A).

There is no limitation on supply voltage wave shape. A square wave voltage permits approximately 100-percent duty cycle, power being limited by the maximum permitted average current. At present, peak currents are limited to 180 ma.

The tube spectral response (Fig. 2C) is shown as count rate versus wavelength for constant total received radiant flux. Knowing the count rate, the total received flux, the tube electrode area, and the fact that each count represents a released electron, permits computation of the quantum efficiency (photons per electron) of the tube electrodes (Fig. 2C). Typical count rates of

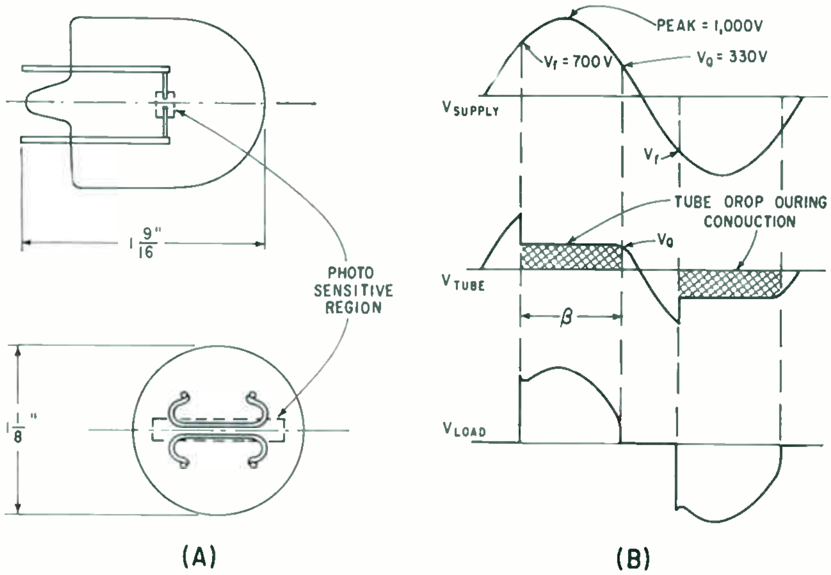


FIG. 1—Edison uv tube (A) provides 5 to 10 w of output power. Waveforms (B) are for supply, tube and load at saturation

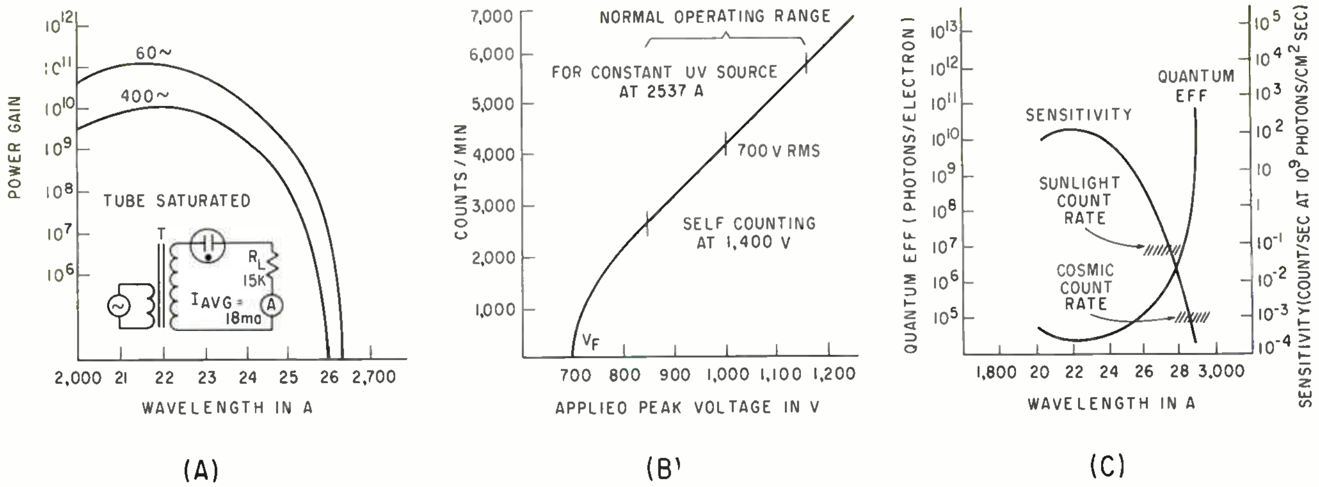


FIG. 2—Power gain (A), count rate (B) and sensitivity and quantum efficiency (C) are for typical tubes

production lot tubes are 30 to 60 counts per sec to the standard signal condition C 12.

A comparison of the 60 cps saturation uv tube current sensitivity ($S_{60} = 2.3 \times 10^8$ amp/w) to the current sensitivity of a multiplier phototube is of interest. Published maximum multiplier phototube sensitivities are given as approximately 800 amp per lumen, referred to a tungsten source at 2,850 K. The over-all luminous efficiency of a tungsten lamp is approximately 25 lumens per w. Hence 800 amp per lumen $= 2 \times 10^4$ amp/w. If the radiant energy source and the multiplier phototube responses are both concentrated at the peak of luminous efficiency, 5,500 A (the peak efficiency of 685 lumens per watt), then the peak sensitivity would be 800 amp per lumen $\times$ 685 lumen/w $= 5.5 \times 10^5$ amp per w.

Thus, the saturated uv minimum tube current sensitivity is several orders of magnitude greater than the maximum sensitivity of a multiplier phototube.

In a sunlit environment a typical C 12 signal-to-noise power ratio is 10 log (4,000 c/m)/(10 c/m) = 26 db. Using a 1-sec integration network requiring a pulse rate of arrival of 600 counts per min (c/m) to reach a predetermined trigger voltage level, the probability of false alarm can be calculated. With a tube having a C 12 rate of 4,000 c/m and invoking the square law rule of radiant intensity fall-off with distance, the circuit can detect the required 600 c/m signal at 31 inches.

By applying laws of probability[2] and assuming the noise level (averaged at 10 c/m) to be a random series of events, the interval between false alarms is 2.8×10^{13} sec or 8.7×10^5 years.

This false-alarm safety factor appears to be more than adequate. Of course the circuit count rate requirement could be lower to improve the system sensitivity. However, if 10^5 such units are in use it is probable that one false alarm will occur every 8 years. This is still acceptable. If the noise level is not due to sunlight, but to cosmic radiation with count rate of 3.33×10^{-3} counts per sec, a false alarm in 5.8×10^{10} years would result if 10^5 units are in use.

These probability calculations are based on the assumption that tube characteristics are stable with time. The long-term stability characteristics of the uv tube are under study.

The parallel connection of several tubes to a common integrating circuit increases the volume under surveillance. Assuming a 1-second integration time, a minimum response signal of 10 c/sec, and an average random noise level of 0.5 counts/sec, the time between false alarms in a three-tube circuit is 180 years.

The deionization time of the tube is approximately 0.3 microsecond. A maximum counting rate approaching 3 Mc is then feasible, opening possibilities in the field of explosion prevention.

Several types of uv fire-detection systems have been constructed. Some detect the absence of a flame, as in a boiler flame-out detection system. Multiple-tube systems have been used for detecting fire in areas such as lumber yards and aircraft engine compartments.

Figure 3A shows an experimental aircraft installation consisting of a control unit, a test-alarm unit and 3 parallel detectors. Each detector can monitor a specific volume, causing a circuit alarm when sufficient uv radiation from a fire actuates a uv tube. The detector package includes an incandescent test lamp whose envelope is transparent to uv radiation. Thus, each detector can be individually checked by actuating its test lamp. Intensity of radiation from the test lamp is voltage adjusted to simulate signal levels of fire.

The detectors are connected in parallel by a two-conductor individually shielded cable. Figure 3B shows how to eliminate cable shunt capacitance effects. Any capacitance shunting the tube terminals would decrease the system signal-to-noise ratio. The twin-wire, twin-shield cabling, plus the location of output transformer T_2, eliminates the cable capacitance problem usually associated with remote detectors.

The distributed cable capacitance of cable 1 (represented by C_1) is continually grounded by the cable shield. This capacitance does not shunt the tube and provide no signal power to transformer T_2. Capacitance C_1 does load power-supply transformer T_1 but this load is easily accommodated. The distributed shunt capacitance of return cable 2 (represented by C_2) provides no shunt path across the tube. Thus C_2 provides no signal power to T_2. When the uv tube conducts due to uv radiation C_2 resonates in series with the leakage inductance of T_2. As long as the time constant introduced by C_2 and the reflected impedance of the integrating network is less than the ½ cycle time of the operating supply frequency, no ill effects results.

For example, using adequate safety factors on a 400-cps system, the cable shunt capacitance should be limited to 5,000 pf for each cable. Commercially available cable has a nominal shunt capacitance of 25 pf per foot. Thus, tube and control box can be at least 200 feet apart. Such systems have been constructed and proved practical.

The system of Fig. 3A will alarm with a delay time of 1 to 2 seconds on a nominal signal of 10 counts a sec. The delay is reduced to 50 milliseconds when the signal level is at saturation (800 counts a sec).

The application of a rapid response system to line-of-sight communications involves consideration of the transmitter radiated power required to saturate the receiver at distance x, atmospheric attenuation and beaming technique. In such a system the uv tube can function as a transmitter as well as a receiver. Other radiation sources with gas filling can also be used.

Figure 4A shows the variation of the exponential atmospheric attenuation[3] constant σ (Km^{-1}). These measurements were made at sea level on a clear day while transmitting in a horizontal direction.

The power collected at the receiver (P_r) is related to the transmitter power (P_t) by $P_r = P_t e^{-\sigma x}$ if we assume lossless reflectors. Figure 4B shows the transmitter power required to saturate the receiver at $\lambda = 2{,}300$ A and $\sigma = 4$ for sea level, clear day, horizontal communication as a function of the separation (in kilometers) between a beamed transmitter and receiver. Ideal beaming is assumed. A received saturation signal is chosen to illustrate the transmitter power required to provide rapid-response, pulse-code type communication systems.

Ultraviolet radiation can be used to communicate between satellites. The magnitude of space noise affecting the uv detector (ultraviolet and gamma radiation) has not been evaluated. Data from present space probes will provide information for system design.

The authors express their appreciation for the contributions of G. M. Anderson, J. B. Johnson, J. Dietz, M. D. Bowers, S. Swietluk, V. Goldschmitt and R. Oufiero.

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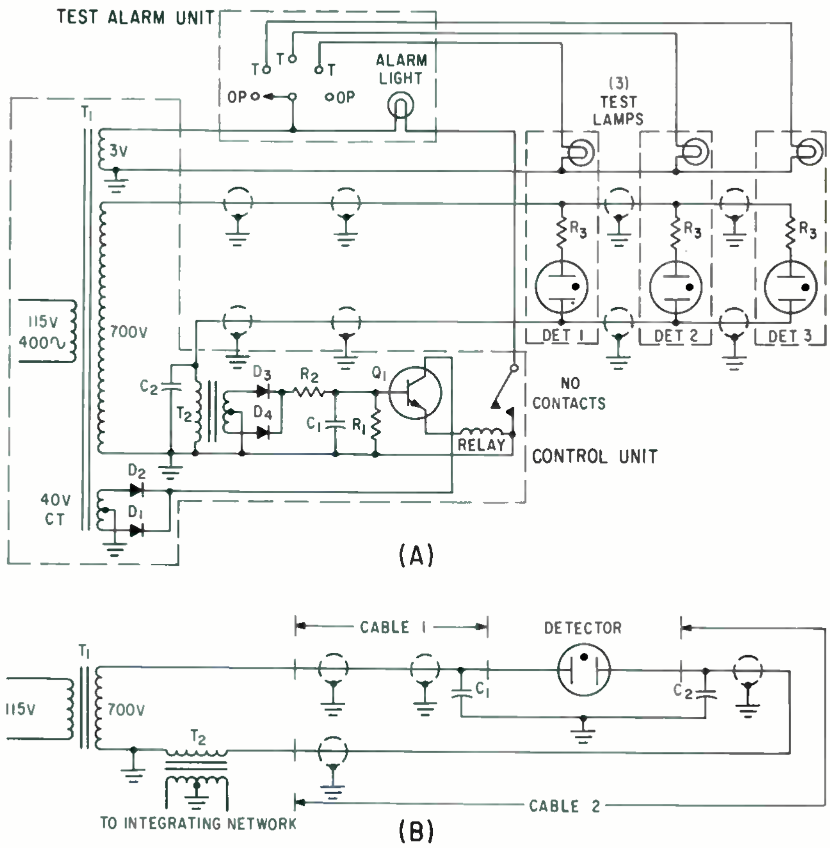


FIG. 3—Multiple-tube fire-detection system (A) has self-checking feature. Remote tube connection circuit (B) compensates for cable capacitance

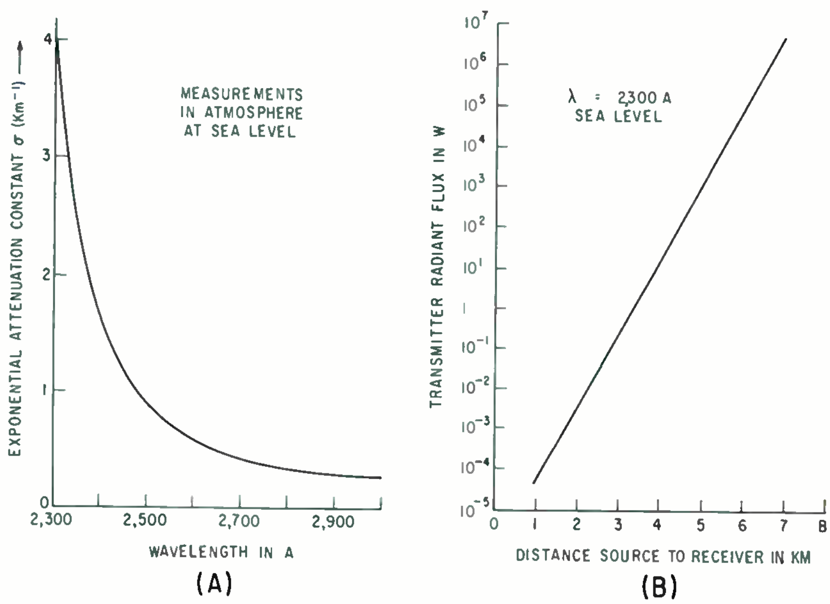
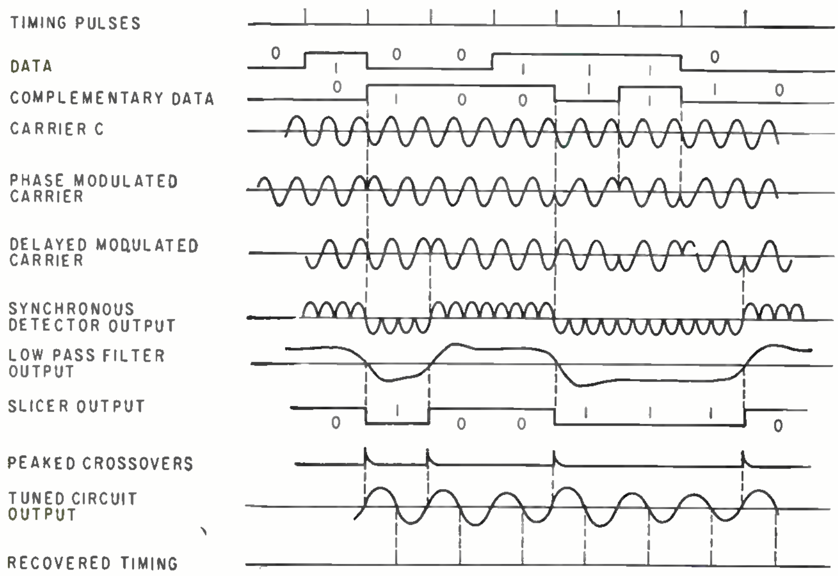


FIG. 4—Attenuation-constant variations (A) and power requirements (B) influence system design

Carrier Phase Reversal Transmits

OPERATION OF IDEALIZED PHASE-REVERSAL MODULATION TECHNIQUE



The illustration below shows waveforms for an idealized phase modulation process where the carrier frequency is twice the bit rate, that is, two cycles of carrier exist in the time interval of one digital bit. The key to the modulation technique is the use of a complementing flip-flop in the converting equipment that operates whenever the data flip-flop receives a one, but does not operate for a zero. In the telephone line system described, a one is represented by a reversal of carrier phase, while a zero is represented by no phase reversal, that is, by transmitting the unmodulated sinusodial carrier.

The telephone line signal is then the unmodulated carrier signal for a train of zeros, while for a series of ones, the carrier signal would be reversed in phase at the end of each bit-time (every two cycles). The phase-modulated carrier is shown, with phase reversals appearing when a one is transmitted.

At the receiving end of the telephone line, the ones and zeros are recovered from the phase-modulated carrier by synchronous detection. One side of the detector is fed directly with the incoming modulated signal, the other side is fed with the same signal but through a one-bit delay line. For a one, the detector inputs are out of phase and the detector gives a negative output; for a zero the inputs are in phase, and the detector output is positive. After passing through a low-pass filter, the detector output is fed to a slicer that recreates the original data pulses. These data pulses are identical (in this ideal case) to the original data pulses but delayed in time with respect to them.

The recreated data pulses at the receiving end also recover correct timing of the operation, permitting data pulses to be gated to computer inputs at the correct time periods.

The basis for generating synchronism is the axis crossing of the detector output. Differentiated output pulses from the slicer, which are coincident with axis crossings of detector output, are fed to a high-Q tuned circuit and its timing-pulse generator, where they reproduce the original timing pulses as shown.

A fundamental snag with this method of regenerating the timing pulses is the need for a series of axis crossing in the detector output. A long series of zeros, for example, would introduce no phase reversals of the carrier, hence no axis crossing of the converter, and consequently no pulses to excite the timing pulse generator.

This article describes a transmitting technique that uses a 5-bit code to ensure continuity of axis crossing and to provide a sync signal that divides the bit train into meaningful words.

A 1,950 cps carrier signal is for zeros. Timing at the

By J. R. MASEK,
Systems Engineer,
The Hallicrafters Co., Chicago, Ill.

ORDINARY TELEPHONE CIRCUITS are among the least expensive and most universally available channels for transmitting digital data. However, a typical telephone line suffers from bandwidth limitations, delay distortion, gain fluctuations and impulse noise—all of which make digital data transmission technically difficult.

An additional complication where computers are concerned is a need for sync (to divide the bit-train into meaningful words) and timing channels in addition to the data channel. This article describes a system used in a Sage data link with several telephone lines and a tropospheric scatter link. The system handles digital data, timing and sync signals in a single channel. It gives an accuracy of 1 bit in 10^6, and can (by transmitting 4 channels over a single line) handle information at a rate equivalent to 64 teletypewriters operating at 100 words per minute.

The system overcomes limitations caused by bandpass and delay distortions inherent in telephone lines by confining the transmitted signal to a 1,200 cps wide channel in the midband of the telephone line operating range (around 1,900 cycles), where it is safe to assume a fairly flat delay characteristic (± 300 μsec).

The single-channel limitation is met by translating the data signal to a redundant code in which sync and timing signals are implicit. The coded signal phase-modulates the subcarrier for transmission over a single channel. At the receiving end the coded signal is demodulated and decoded, and the sync and timing signals recovered.

Digital Data Over Telephone Lines

reversed in phase every time a digital one is to be transmitted, and left unmodulated

receiver is recovered from axis crossing of the incoming information

There are several ways of transmitting sync and timing signals along the same channel as the data signal. One is to use separate subcarriers; another introduces additional modulation levels to the original carrier.

Separate subcarriers require complex compensation for delay distortion to maintain phase relations between subcarriers. Multiple-level modulation would require several slicing levels in the receiver and good amplitude stability throughout the system—two factors that nullify some of the advantages of digital systems.

The code translation system described here accommodates sync and timing information in the transmitted data signal by taking the incoming information in groups of four bits, translating it to a five-bit code and sending the information along the telephone line at a 25 percent higher bit rate. At the receiving end the original 4-bit code groups, timing, and sync signals are recovered.

The table shows the code translation scheme. The 16 possible 4-bit groups are translated to 16 of the possible 32 groups of five bits. One of the left-over groups (10000) is used for the sync signal. The sync signal can always be identified because it is impossible to get four consecutive zeros by any serial combination of the other 16 groups; and no more than three zeros or seven ones can occur in succession in the translated data signal, so timing can easily be recovered from one/zero crossovers.

The timing input in the block diagram overleaf is a 1,300-cps sine wave. Sync and data input signals are 1,300-cps dipulses—that is, one full cycle of a 1,300-cps sine wave per bit. Input processing operations have been omitted.

The timing signal is amplified, phase-shifted and squared to produce a timing square wave (t_1) and differentiated to produce a train of negative pulses t_2, both at 1,300 cps. The sync and data signals are amplified and sliced at +2 volts to form square pulses.

The square-wave timing signal t_1 drives the 4-bit shift register and the four counter, which is made up of two flip-flops in cascade. The first flip-flop (F_1) counts down to a 650-cps square wave and the second (F_2) produces a 325-cps square wave. The 650-cps square wave is fed to a narrow-band filter that selects the third harmonic and generates a 1,950-cps sine wave for the phone-line carrier. The 325-cps signal is also passed through a narrow band filter that selects the fifth harmonic for the 1,625-cps square-wave clock (t_3) that drives the 5-bit register. Thus, with the 4-bit register driven at 1,300 cps, and the 5 bit register at 1,650 cps, data bit rate is increased in the ratio 5:4, as required.

CODE TRANSLATION SCHEME

Original Data		Translated Data
$D_1D_2D_3D_4$		$P_1P_2P_3P_4P_5$
0 0 0 0	BECOMES	0 0 1 1 1
0 0 0 1		0 1 1 1 0
0 0 1 0		0 0 1 0 1
0 0 1 1		0 0 1 1 0
0 1 0 0		0 1 0 1 1
0 1 0 1		0 1 0 1 0
0 1 1 0		0 1 1 0 1
0 1 1 1		0 1 0 0 1
1 0 0 0		1 0 1 1 1
1 0 0 1		1 1 1 1 0
1 0 1 0		1 0 1 0 1
1 0 1 1		1 0 1 1 0
1 1 0 0		1 1 0 1 1
1 1 0 1		1 1 0 1 0
1 1 1 0		1 1 1 0 1
1 1 1 1		1 1 0 0 1
sync		1 0 0 0 0
4 3 2 1		5 4 3 2 1

Data pulses are gated to the 4-bit register at 1,300 bits per second. After every 4th bit, the contents of the 4-bit shift register are transferred through the code translation matrix to the 5-bit shift register. The contents of the 5-bit register are gated continuously to the modulator at 1,625 bits per second. The phase of 5-bit register drive pulses, t_3, is adjusted to that the 5-bit register does not advance at the same time as the code translation matrix is feeding in new data.

Order is established by the input sync pulse, which is gated to sync flip-flop S_1 and S_2. Flip-flop S_1 resets the four counter to its initial state and also sets up S_2 which in turn controls the action of the transfer pulse generator. The transfer pulse generator produces a pulse after every fourth count—that is, when F_1, F_2 = 1, 1.

When S_2 is present, and this occurs once for every word from the computer, transfer sync pulse X_2 is gated to the 5th-bit position of the 5-bit register to produce the 10000 sync code. When S_2 is not present, transfer data pulse X_1 gates the contents of the 4-bit register through the translation matrix to the 5-bit register. The transfer sync pulse X_2 removes S_2 (from the transfer and X_2-pulse generator) so that X_1 is automatically produced when next F_1, F_2 = 1, 1; that is four timing pulses later.

The contents of the 5-bit register

are fed serially to the modulator to reverse the phase of the 1,950-cps carrier every time a one is present.

The modulator combines the output of two bridge circuits. Every time the logic information inputs P_1 and P_2 from the 5-bit register reverse phase (signifying a one from the 5-bit shift register), the modulator switches the carrier through 180 deg. The modulated carrier is then filtered to remove the 2,600 cps upper-sideband, leaving the signal-energy concentrated at 1950 cps for zeros and 1300 cps for ones, giving a net bandwidth of 650 cps.

At the receiving end, the phase-modulated carrier is amplified and (referring to the editorial box) passed through a 1-bit delay line. Both the delayed and undelayed carrier are passed through symmetrical limiters to preserve only the phase information in common-amplitude signals of about 1 volt peak-to-peak. These are applied to the synchronous detector circuit, which delivers a negative output for zero signals and a positive output for ones.

The synchronous detector output is then filtered, sliced to a ground reference, and inverted to quantize the incoming demodulated signal as a digital square wave P_1, which is then fed serially into the 5-bit shift register of the receiver.

A peaking circuit feeds the P_r crossovers to a high-Q tuned circuit that recovers the 1625-cps timing from the changing data by generating a 1,625-cps sine wave. The 1,625-cps sine wave is converted to timing square wave t_3 and negative pulse train t_4. The 1.625-cps pulse train t_3 gates logic pulses P_r to the 5-bit shift register, while the 1,625-cps square wave t_4 advances 5-bit shift register and t_4 advances the five counter.

The five counter is a cascade arrangement of three flip-flops that resets itself after every five input cycles (it can also be reset for synchronization by the sync recovery output S_3). The five counter generates an unsymmetrical square wave J_2 for passing through a narrow-band filter in the timing generator that selects the fifth harmonic and excites a 1,300-cps tuned circuit and a timing pulse generator for reproducing the original timing waves at 1,300 cps.

The five counter also generates timing wave J_4 that identifies every fifth bit of the incoming data signal once it has been put into step by signal S_3 from the sync-recovery circuit. The sync recovery circuit is a logic circuit that generates a pulse (S_3) whenever the 5-bit shift register contents are $P_1P_2P_3P_4P_5 = 10000$. The S_3 pulse resets the five counter and gates a transfer-sync pulse X_3 to the sync shift register. Sync signal S_4 is then gated to the sync output modulator by t_5.

Once the five counter has been put into step by S_3, every subsequent J_4 pulse, excepting those coincident with sync-recovery pulse S_3, gates a transfer data pulse X_3 from the transfer pulse generator to send the contents of the 5-bit shift register through a retranslation matrix to recover the original data signal in the 4-bit shift register, which is then read out by t_5. Those five-counts occurring when the 5-bit register content is 10000 do not result in retranslation matrix operation, but instead, channel a pulse to the sync shift register, where the pulse is ultimately delivered as an output sync pulse.

Both sync and data signals are finally converted to 1,300-cps dipulses—their original form—for subsequent processing.

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(1) K. E. Perry, Phone Line Data Systems, MIT Lincoln Laboratory Group Report M24-54.
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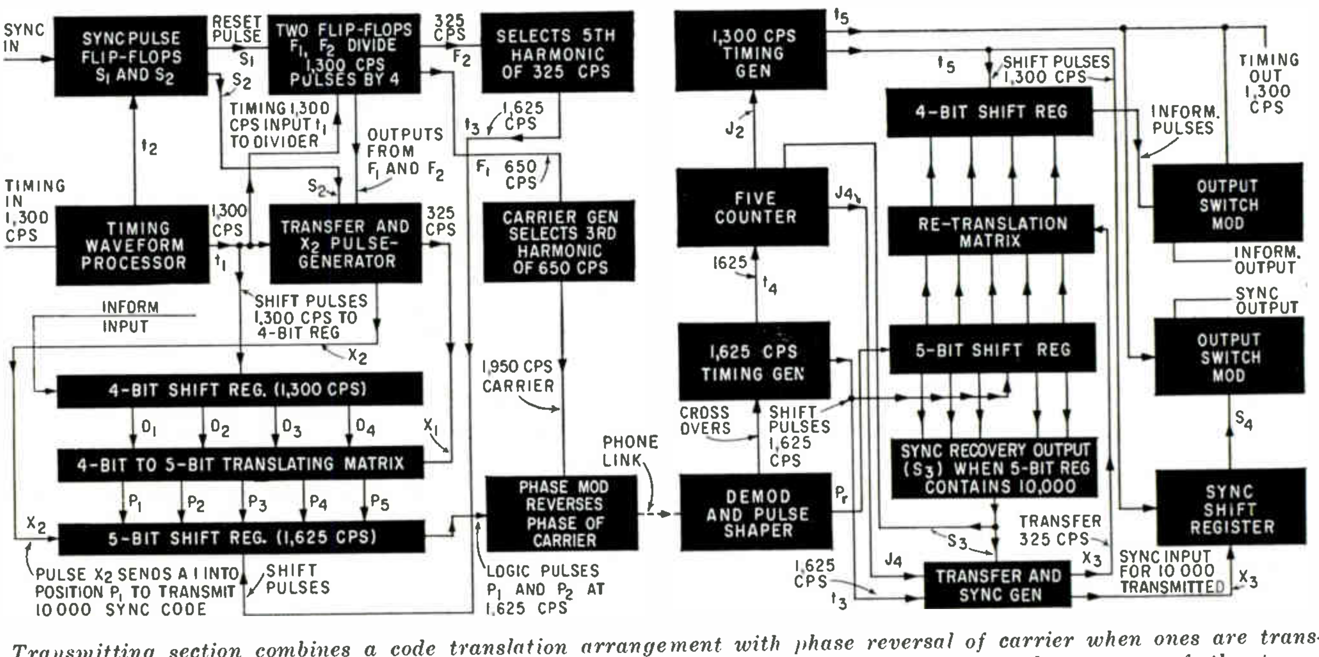
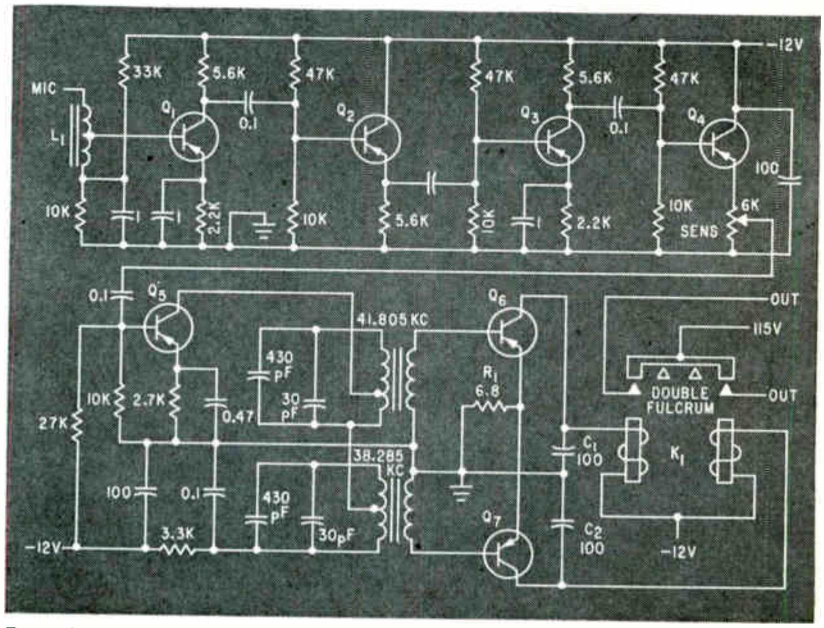


Transmitting section combines a code translation arrangement with phase reversal of carrier when ones are transmitted. The transmitter also transmits sync pulse as a 1000 code. Receiver action is the reverse of the transmitter; its outputs are timing, information and reconstituted sync signals

Transistor Amplifier Controls Remote Appliances

Ultrasonic device has seven-transistor circuit, operates with double-fulcrum relay



Broadband noise operates both sides of double-fulcrum relay preventing application of power to appliance. Output leads can supply power to motors, relays or other controlling devices

ALTHOUGH originally designed for remote control of tv sets, this transistorized ultrasonic unit can control many other types of consumer appliances.

Theoretically, a five-stage amplifier can perform the switching operation. However, the combination of matching losses, critical h_{fe} and line-voltage variations resulted in the development by the Admiral Corp. of the seven-stage circuit shown.

This circuit can use transistors with beta spreads from 20 to 200, thus reducing costs and making use of available transistors. For the first five stages, transistors having h_{fe} ranging from 20 to 75, or over 150, and those having high collector breakdown voltages are suitable. Transistors having h_{fe} between 75 and 150 are used in the output stages.

The main design problem of thermal runaway resulting from temperatures as high as 165 F inside the sets was only partially solved by development of capacitors and other components rated to approximately 160 F. Increasing the value of the emitter resistor of amplifiers Q_1 and Q_3 provides thermal protection with minimum loss of gain.

The second major design problem, that of spurious ultrasonic signals from jingling coins, keys or telephone bells triggering the control relay was overcome by designing the frequency discriminator to combine the selectivity of two tuned circuits and the gain of two transistor amplifiers with a relay capable of acting as a mechanical discriminator.

The first five stages, Q_1 and Q_5 amplify signals between 38.285Kc (one control frequency) and 41.805 Kc (the other control frequency) and are tuned to a symmetrical double-peaked curve by the combined mechanical resonance of the microphone, microphone and cable capacitance and inductor L_1.

Tapped inductor L_1 couples the microphone to the amplifier with the tap representing a compromise between impendance matching and microphone loading.

Two parallel-tuned circuits, each tuned to one of the control frequencies, are connected in series to form the collector load for driver amplifier Q_5. The primary winding of the two tuned circuits have high Q's to prevent overlapping response under maximum signal input.

Losses resulting from emitter resistor R_1 are compensated by uniform gain despite differences in transistor emitter resistances. This resistor also back biases relay control transistors Q_6 and Q_7 under strong signal conditions to prevent overloading and eliminate the need for agc.

Output stages Q_6 and Q_7 operate as class-B detector amplifiers to eliminate the need for separate diode detectors. Maximum power efficiency and component economy result from loading input signals only during forward conduction of the transistors.

Collector to ground capacitors C_1 and C_2 integrate the half-wave signal pulses and absorb high-voltage transients produced by the relay inductance. Special relay K_1 operates on the double-fulcrum principle. Broadband noise falling within the passband or on both control frequencies simultaneously, causes both relay coils to be energized. The resulting magnetic fields balance the mechanical forces on both sides of the stabilized double-fulcrum preventing any mechanical action.

When only the desired control frequency is received, the pertinent coil of relay K_1 is energized and closes a mechanical contact that applies power to the remotely controlled appliance.—C.M.W.

Interstage

Stagger-loading low-pass

By L. A. BEATTIE,
Dept. of Electrical Engineering,
University of Idaho, Moscow, Idaho

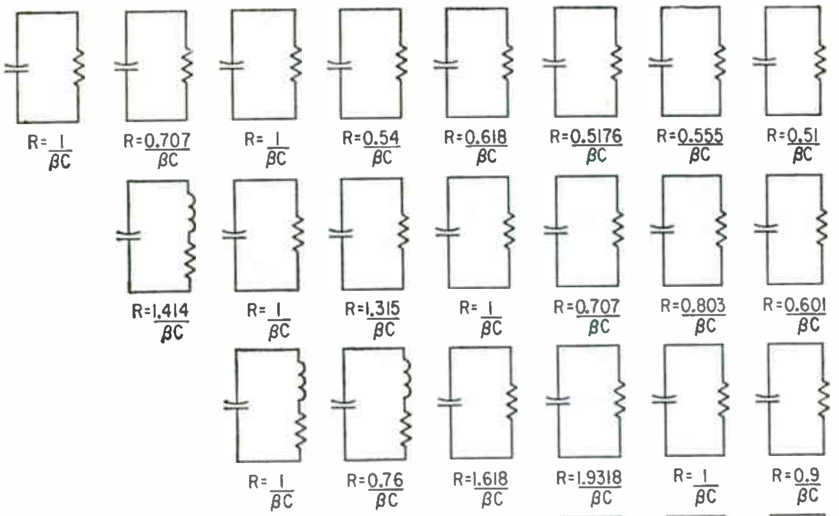
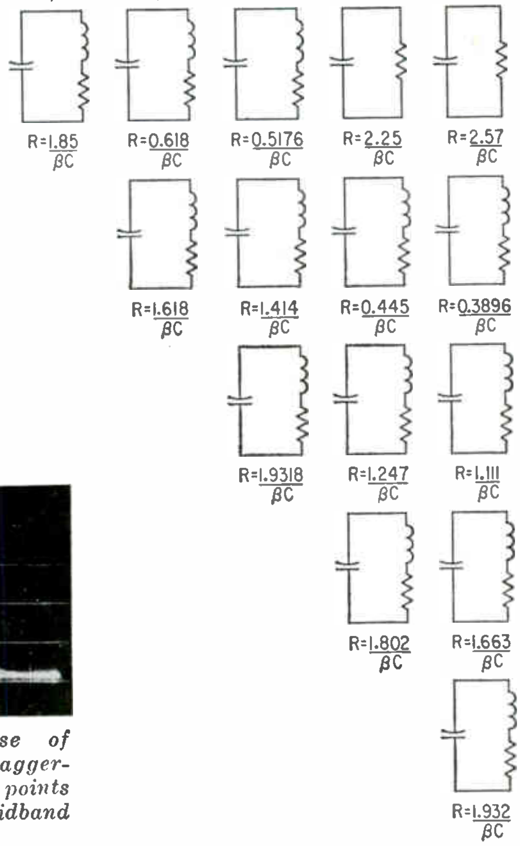
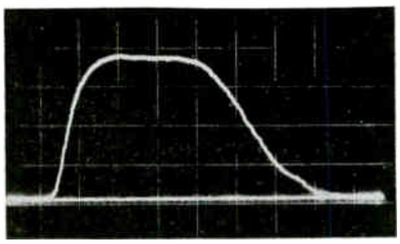



TABLE I—Butterworth low-pass staggered coupled amplifier interstages. All have the same capacitance C, and all inductances, have the value $L = 1/\beta^2C$ where β is the amplifier half-power bandwidth in radians per second



Overall frequency response of seven-stage Butterworth stagger-loaded amplifier. Half-power points are 2.7 Mc and 25 Mc, midband gain is 95

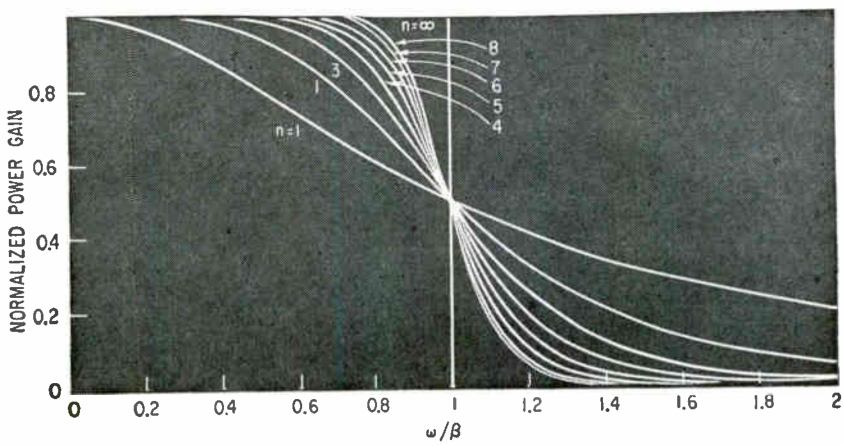


FIG. 1—Butterworth functions are plotted as normalized power gain against normalized frequency

THE BUTTERWORTH STAGGER-TUNED bandpass amplifier is popular for achieving large gains over large bandwidths. Staggered adjustment of interstages has been also used at low frequencies, as for example when a cascade of r-c coupled stages is followed by a stage or two of shunt-peaked amplifiers. However, the low-pass stagger designs are usually determined by curve fitting or by maximally flat adjustment of all shunt-peaked stages. Conventional methods of low-pass amplifier design have the disadvantage that the bandwidth shrinks as stages are cascaded; however, it must be admitted that the simple methods result in amplifiers with simple interstages.

Characteristics of Butterworth stagger-tuned bandpass amplifiers show that the undesirable shrinkage of bandwidth due to stage cascading can be overcome, because the gain of a staggered n-tuple is $(g_m/\beta C)^n$, the nth power of the gain of a single stage operating at bandwidth β. In this expression, β is the half-power bandwidth of the n-tuple in radians per second, and C the total interstage capacitance per stage. In return for this lack of bandwidth shrinkage within the n-tuple, circuit complexity increases, and in turn causes greater adjustment difficulties.

When gain and bandwidth requirements are not great, simple circuits can be used; however, circuit complexity begins to pay off in designing amplifiers with large gain and bandwidth requirements.

This article describes a family of low-pass Butterworth amplifiers with the same general characteristics as the Butterworth bandpass stagger-tuned amplifiers. These low-pass amplifiers are also stag-

Design for Stagger-Loaded Amplifiers

amplifiers overcomes bandwidth problem due to cascading of stages

gered, because each amplifier stage has a different load impedance resulting in different gain-frequency characteristics for the various tubes. For these low-pass amplifiers, the expression stagger-loaded is more appropriate than stagger-tuned.

The Butterworth functions have the mathematical description $f(\omega) = 1/(1 + \omega^{2n})$, or $f(\omega) = 1/[1 + (\omega/\beta)^{2n}]$. Both functions have maximum magnitude of unity at $\omega = 0$, and decrease as frequency increases. The first function has a magnitude 1/2 at $\omega = 1$, and the second function equals 1/2 at $\omega = \beta$. The second function is plotted in Fig. 1 for various n vs. ω. The function has been interpreted as the normalized power gain of an amplifier.

The frequency characteristics of the Butterworth functions are their principal justification. Increasing n results in flatter behavior in the region $\omega = 0$, and there is a sharper drop as ω approaches β. Changing n does not change the half-power point of the function. When a flat frequency response is desired, a relatively large n is required. As n approaches infinity, the Butterworth function approaches a shape that is perfectly flat with magnitude 1 from $\omega = 0$ to $\omega = \beta$. Then it drops vertically to zero at $\omega = \beta$ and remains there.

To derive expressions for a Butterworth low-pass staggered triple circuit, consider a Butterworth function, taking $n = 3$, and interpret it as a magnitude squared function. Thus $|F(j\omega)|^2 = 1/(1 + \omega^6)$; replace ω by p/j, obtaining $G(p) = 1/(1 - p^6)$. Form a function with only the left half-plane zeros and poles of $G(p)$; the result, $F(p) = 1/[(p + 1)(p^2 + p + 1)]$ is exactly that function whose magnitude squared is the given Butterworth function when p is put equal to $j\omega$.

Consider now an n-stage amplifier without feedback, whose interstage networks are driving-point impedances. The voltage gain is $G = G_1G_2 \ldots G_n = (g_mZ_1)(g_mZ_2) \ldots (g_mZ_n) = g_m{}^nZ_1Z_2 \ldots Z_n$. The gain is a pure numeric, times the product of all interstage impedances. If, now, the $F(p)$ function can be considered as the product of the driving-point impedances of the interstages, the amplifier has a magnitude of gain squared which would be the desired Butterworth three-pole function.

Since the function in its present form will not factor, it can be modified so that factoring is possible by multiplying by unity. Thus $F(p) = [1/(p + 1)\ (p^2 + p + 1)]\ [(p + a)/(p + a)] = [1/(p + 1)]\ [1/(p + a)]\ [(p + a)/(p^2 + p + 1)] = Z_1Z_2Z_3$. Selecting $a = 1$ for simplicity, the following impedances result: $Z_1 = 1/(p + 1)$, $Z_2 = 1/(p + 1)$ and $Z_3 = (p + 1)/(p^2 + p + 1)$. Applying bandwidth transformation (divide by β) and impedance level transformation (divide by some constant) the three networks have been derived. At low frequencies all reduce to a pure resistance $1/\beta\ C$.

The table shows the interstage networks for low-pass stagger-loaded amplifiers up to and including the staggered octuple. These are a cascade of R-C coupled stages and shunt-peaked stages with various bandwidths and various degrees of peaking. All coils for all the networks have the same value, $1/\beta^2C$. All capacitors have the same value, C. The difference between stages is determined by the resistance values and by whether or not they have peaking coils.

In any column of impedances for an n-tuple, the product of resistances is $1/(\beta C)^n$, thus showing that the low-frequency voltage gain of a staggered n-tuple is $(g_m/\beta C)^n$. The magnitude squared of the voltage gain divided by the loading resistance of the last tube will be the power gain of the amplifier, thus justifying the labeling of the Butterworth function curves as normalized power gain curves.

As an example of the behavior of individual stages within an n-tuple, Fig. 2A shows the normalized plots of power gain against frequency for individual stages within a quadruple and for the overall quadruple. Similar plots may be made for other n-tuples from the networks of the table. The dashed curves of Fig. 2A show the response of individual stages, while the solid curve shows the response

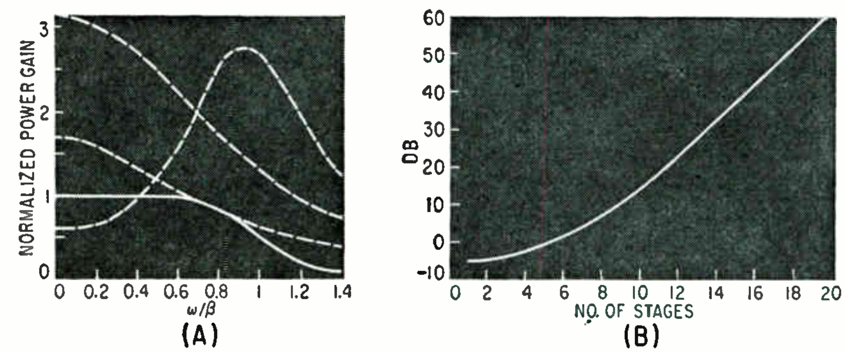


FIG. 2—Normalized power gain of individual stages with a staggered quadruple (dotted lines) and of the overall quadruple (solid line) is plotted against frequency in (A); gain-bandwidth advantage of n-stage Butterworth amplifiers relative to an n-stage cascade of maximally flat shunt-peaked stages is plotted in (B)

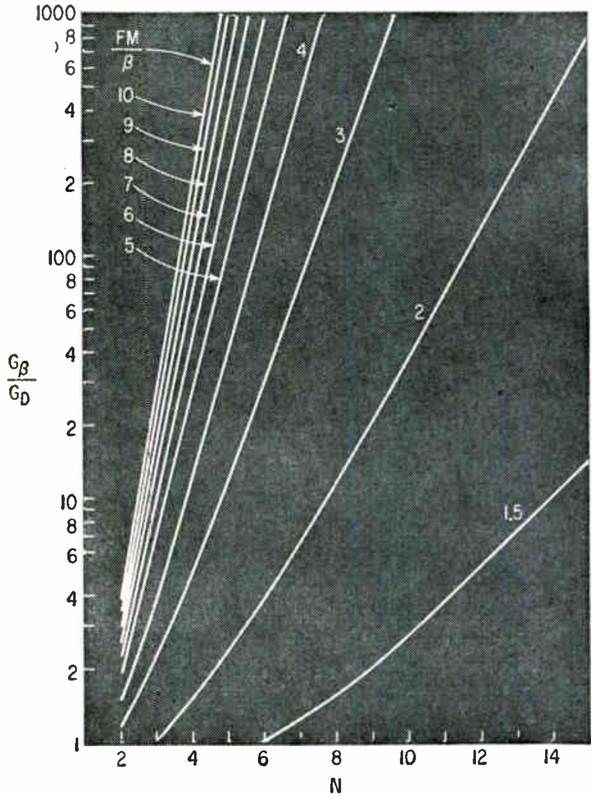


FIG. 3—Comparison of the gain of the stagger-loaded Butterworth amplifier with the gain of a distributed amplifier, as a function of the number of tubes

of the overall amplifier.

The gain curves presented here extend down to zero frequency. However, this frequency behavior can only be realized with d-c coupling. If capacitive coupling and bypassing is used to establish d-c operating points, the gain will fall off at low frequencies because of the reactance of the capacitors. However, the design for some given lower half-power point frequency can be a separate consideration. The low-frequency techniques used on more conventional amplifiers can be used without modification.

Another consideration relates to linearity. In deriving the design equations it was assumed that the g_m of the tubes was constant. This will not necessarily be true unless care is taken that the signal level does not become so large as to saturate the output tube. Under large signal conditions, the frequency response of the amplifier will tend to take the shape of the response of the last tube. Thus extreme frequency distortion can result. This difficulty can be minimized by selecting the last stages to be broad band (most of the n-tuples have at least one or two inherent broad-band stages). Frequency response tilt under saturation is also experienced in bandpass stagger-tuned amplifiers. However, there the output of the amplifier is more naturally low level in most applications, since the output of the bandpass amplifier will typically drive some load such as, for example, the detector in a receiver. Here good design and agc can insure small signal operation. For the low-pass amplifier, the output requirement will more typically be large. For example, the output may drive the deflection plates of a cathode-ray tube. Many large-signal applications may therefore preclude use of the low-pass staggered amplifiers.

The advantages of the low-pass staggered amplifiers disappear for low gain and low bandwidth requirements. It is only for extreme requirements that they might be useful. It is simpler and actually advantageous for amplifiers with modest requirements to have every stage shunt peaked maximally flat. However, the bandwidth shrinkage of even the maximally flat shunt-peaked amplifier, as stages are cascaded, results in low stage gain for large bandwidths. Figure 2B plots the gain-bandwidth advantage of an n-stage Butterworth amplifier against an n-stage cascade of maximally flat shunt-peaked stages. It is only above five stages that the Butterworth amplifiers begin to come into their own.

The distributed amplifier is another type which has been used for significant gain over extreme bandwidths.

The voltage gain of an n-stage stagger-loaded Butterworth amplifier has been shown to be $G_B = (g_m/\beta\, C_{total})^n = (FM/\beta)^n$, where C_{total} is the total interstage capacitance in the amplifier, and FM the figure of merit of the tube. In a distributed amplifier, the plate line characteristic impedance is given by $Z_{op} = (L/C_{out})^{\frac{1}{2}}$, where L is the inductance per section in a constant-k filter, and C_{out} is the output capacitance of the tube. For this plate line the cutoff frequency is (bandwidth of the distributed amplifier) $\omega_c = \beta = (LC_{out})^{-\frac{1}{2}}$.

Therefore, the L per section for a given bandwidth is $L = 1/\beta^2 C_{out}$. Using this value in the Z_{op} equation, $Z_{op} = 1/\beta C_{out}$. The voltage gain of a distributed amplifier is given by $G_D = (n/2) g_m Z_{op} = g_m n/2\beta C_{out}$. Taking the ratio of G_B to G_D, $G_B/G_D = (2C_{out}/nC_{total})\ (FM/\beta)^{n-1}$.

The average of C_{out}/C_{total} for a large number of tubes is approximately 0.372. Thus $G_B/G_D \cong (0.746/n)\ (FM/\beta)^{n-1}$. This equation is plotted in Fig. 3 for various values of the parameter FM/β against n, the number of tubes in the amplifier. For bandwidths significantly less than the figure of merit of the tube, the staggered amplifier has an appreciable gain advantage compared with the distributed amplifier. However, when the amplifier bandwidth exceeds the figure of merit of the tube, the distributed amplifier surpasses in performance the stagger-loaded amplifier. Then the stagger-loaded amplifier must have a gain less than unity, but this is not true for the distributed amplifier. This breakover point occurs because the gains of the tubes in any cascaded amplifier multiply, while the gains of the various tubes in the distributed amplifier add. Thus, it is possible to realize significant gain in a distributed amplifier over bandwidths exceeding the figure of merit of the tube.

For narrow-bandwidth or low-gain applications, simple amplifier types are useful. As requirements become more stringent, the designer usually resorts to shunt peaking to preserve bandwidth as stages are cascaded. If the amplifier requires more than five stages of shunt-peaked amplification, then there is a definite advantage to the stagger-loaded amplifier until the overall amplifier bandwidth approaches the figure of merit of the tube. If the ratio of figure of merit to amplifier bandwidth is less than 1.25 to 1.5 then the designer is forced to use distributed amplification. The stagger-loaded low-pass amplifier fills a void between the shunt-peaked amplifier and the distributed amplifier.

One other point is the ease with which d-c coupling can be accomplished. Here, the cascaded amplifier of any type suffers a disadvantage over the distributed amplifier. In the cascaded amplifier, a d-c supply voltage is required that is essentially equal to the sum of the supply voltages of all the tubes in the amplifier. For a cascade of a large number of tubes, this voltage can become excessive. For the distributed amplifier, the supply voltage requirement is only equal to that of a single tube within the amplifier. Thus, where d-c coupling is necessary, the distributed amplifier has a distinct advantage in power-supply voltage requirements even though a given number of tubes may not furnish the maximum possible gain.

An amplifier has been built using the principles described. No emphasis was placed upon low-frequency response. The lower half-power point was 2.7 Mc; however, this could have been reduced to the audio range by using larger coupling and bypass capacitors.

A seven-stage amplifier using 6AK5 tubes was designed for a bandwidth of 30 Mc. For the type of construction used it was estimated that the total interstage capacitance would be 15 picofarads. Using this value, the interstage networks were designed with the equations shown in Table I. These networks are shown in Fig. 4A.

Since all stages were identical except for the interstage load impedances, only a single stage need be shown; this appears in Fig. 4B.

The overall amplifier was wired using 10-percent resistors. Powdered-iron tuning slugs were used on the shunt-peaked stage inductances. All three inductances have the same value, and this value resonates the interstage capacitance at the upper half-power point of the amplifier, 30 Mc. The three coils were adjusted with a signal generator supplying a 30-Mc signal at the input and a high-frequency voltmeter connected to the output. The resistance in the first shunt-peaked stage was temporarily shorted out. This caused that stage to be sharply resonant, thus causing a peak in the output voltage at the resonant frequency between the peaking coil and the interstage capacitance. The coil was then adjusted until this resonance occurred at 30 Mc. The short circuit was then removed from the resistance. The other two shunt-peaked stage coils were then adjusted in the same way. The overall amplifier response was measured using a swept input signal provided by conventional sweep equipment. Upon observing the amplifier response, a slight tilt in the passband was noted. This was corrected by adjustment of the tuning coils in the shunt-peaked stages. The final shape of the over-all amplifier passband is shown in the photograph. The half-power points occurred at 2.7 and 25 Mc. The disagreement between 25 Mc and the design upper half-power point of 30 Mc is traceable to an interstage capacitance in excess of 15 picofarads. This resulted because of the type of shielding used between tubes, the signal being fed through a shield from one tube to the next. The overall measured midband gain was 95. The calculated midband gain is 195, a discrepancy of about 6 db. This was probably caused by the heavy bias.

With the 150-ohm bias resistors the g_m of the tubes would be considerably less than the 5,000 micromhos as stated by the tube manual. The synthesis methods involved in this paper could be applied equally well to other functions; in particular, the method could be used to derive staggered low-pass amplifiers with Tschebyscheff behavior. These Tschebyscheff amplifiers would have pass bands with equal ripple characteristics, and, in general, could furnish greater gain over a given passband than the Butterworth amplifiers.

Because Tschebyscheff amplifiers have an arbitrary design parameter, the ripple, it is not possible to tabulate the interstage networks in as simple a manner as for the Butterworth amplifiers.

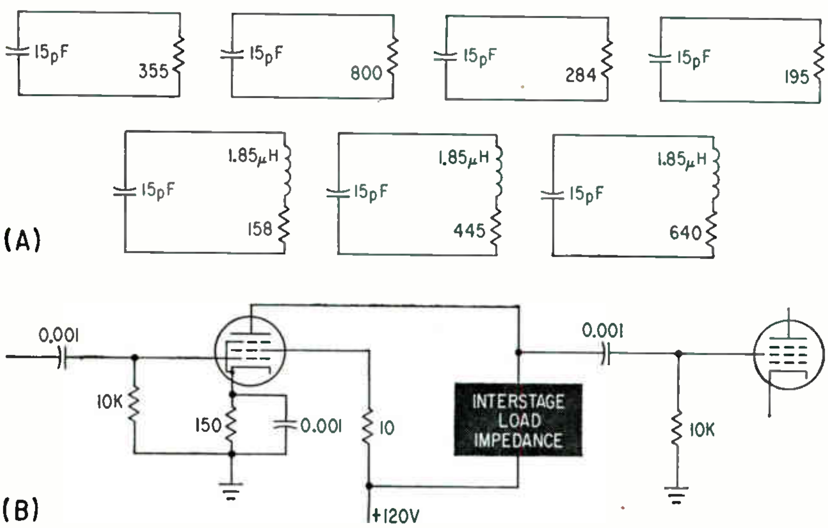


FIG. 4—Interstage networks for seven-stage amplifier example, using 6AK5 tubes, for a bandwidth of 30 Mc, are shown in (A); typical stage is shown in (B)

Evaluating Transmission Methods

By JOSEPH H. VOGELMAN,
Capehart Corp., Richmond Hill, N. Y.

EVALUATION OF TRANSMISSION media requires the establishment of criteria that relate their effectiveness as a function of cost and the service they furnish. Value and conditions of operation for military and civilian circuits differ in the extent that reliability and availability of circuits requirements are affected by different conditions. For civilian communications, finite, average delay times can be stipulated on the basis of average traffic loads. The system can tolerate large delays under overload conditions. Interferences to the circuit performance are either natural or unintentional man-made effects. In the military case, in addition to the problems normally confronted by a civilian communication system, the allowable delays are considerably shortened and the system must meet its design objective under maximum loading rather than average. This imposes additional burdens on the complexity of circuits, the number of channels, the complexity of switching and the general overall reliability. It also requires the inclusion of intentional man-made interference in any analysis.

The tables give the advantages and disadvantages of the various transmission media for both civilian and military uses, and specific data. Each medium is considered by frequency band where this contributes significantly to its utility or cost.

TABLE I—SPECIFIC DATA FOR TRANSMISSION SYSTEMS

Freq	Transmission Medium	Range in Miles	Number of Voice-Bandwidth Channels Per Equipment	Nominal Antenna Size in Ft	Transmission Bandwidth in Kc	Nominal Average Power in Kw
VLF	Ground Waves	12,000	0.1	>1,000	0.3	100
L-F	Ground Waves	5,000	1	1,000	6	50
M-F	Ground Waves	100	1	200	10	50
H-F	Ionospherically Reflected Waves	12,000	1	100	6	10
VHF	Ionospheric Scatter	1,500	1	200	25	10
	Line of Sight	20 and	1	3	25	0.01
		200 air	1	3	25	0.1
	Meteoric Scatter	1,500	0.1	20	100	1
UHF	Line of Sight	20 and	1	2	100	0.01
		200 air	1	2	100	0.1
	Tropospheric Scatter	200	2,000	50	20,000	50
		500	150	100	1,000	100
	Active Satellite Relay	12,000	2,000	50	10,000	1
	Passive Satellite Relay	15,000	2,000	100	10,000	1,000
	Line of Sight	15	5,000	10	50,000	0.001
	Courier Satellite	15,000	100 storage	50	10,000	1
	Tropospheric Scatter	200	48	50	200	10
	Lunar Reflection	500,000	4	100	32	100
Closed Circuits	Open Wire	50	4	.....	16	0.01
	Coaxial Cable	5,000 with repeaters	5,000	.....	25,000	1
	Undersea Cable	5,000 with repeaters	24	.....	100	1
	TE_{01} Circular Waveguide	5,000 with repeaters	250,000	.....	1,000,000	10

TABLE II—CLOSED SYSTEMS

Transmission Medium	Area of Exploitation	Advantages: Military	Advantages: Commercial	Disadvantages: Military	Disadvantages: Commercial
Open Wire	Voice or Data	low cost simple privacy propagational reliability	low cost simple privacy propagational reliability	subject to physical damage narrow bandwidth fixed terminals low info capacity requires right of way control limited by water bodies frequent repeaters	narrow band width subject to weather damage low info capacity needs continuous right of way geographic obstacles limit use frequent repeaters
Coaxial Cable	Voice, Data or Video	trunk capability privacy large info rate reliability	trunk and long range capability privacy multichannel capability reliability	subject to physical damage fixed terminals requires right of way control limited to land mass frequent repeaters	subject to weather and mech. damage needs continuous right of way limited by geography frequent repeaters
Undersea Cable	Voice and Data	long range reliability privacy	long range trunk multichannel reliability privacy	subject to enemy action fixed terminals requires protection frequent repeaters	cost frequent repeaters limited band width need for continuous right of way
TE_{01} Circular Waveguide	Voice, Data and Video	unlimited channels unlimited bandwidth reliability long range	major trunk capability long range unlimited channels and bandwidth privacy, reliability	subject to enemy action fixed terminals requires protection	initial cost geographic limits need for continuous right of way

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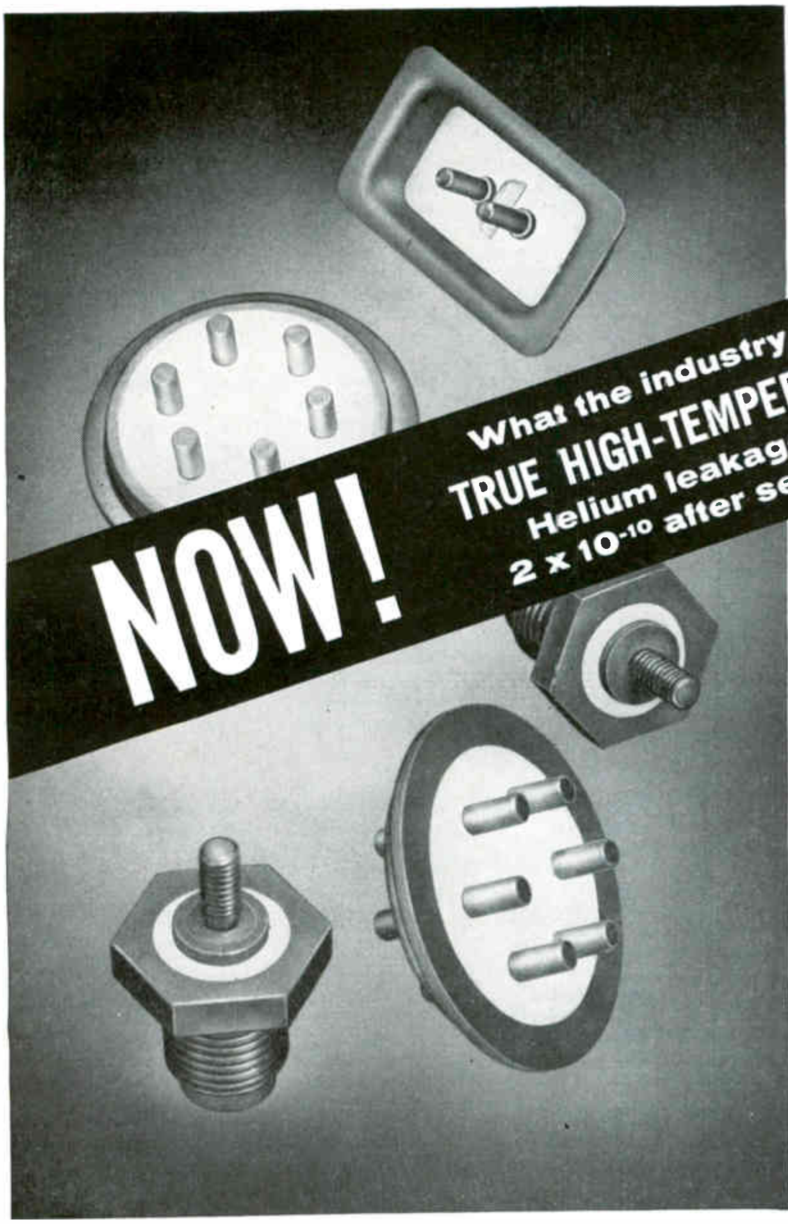

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  2. Samples heat shocked a total of 5 cycles, from 350°C. for 1 hour directly to room temperature for 10 minutes, to -70°C. for 1 hour, to room temperature for 10 minutes.
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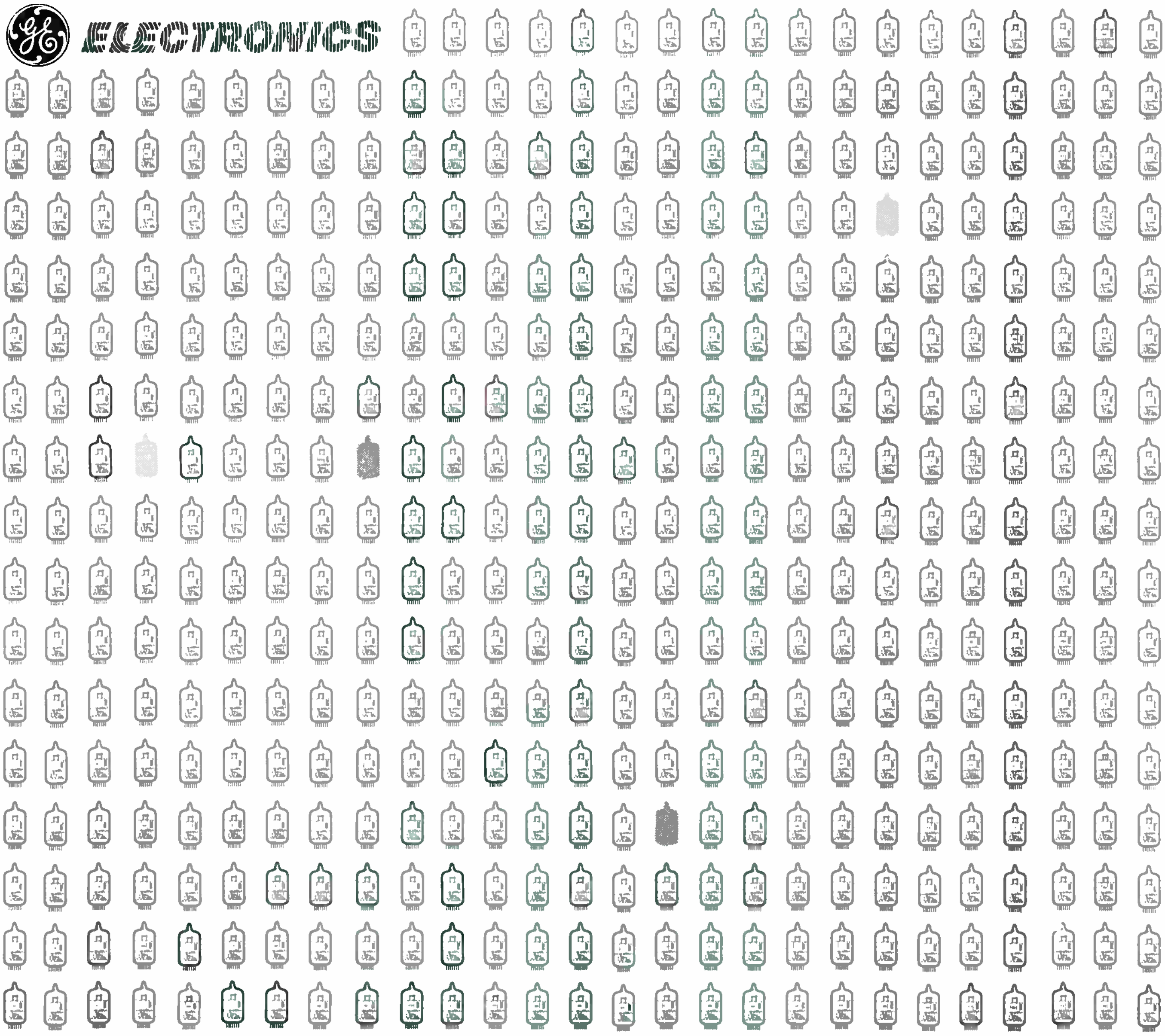
TABLE III—INFORMATION TRANSMISSION METHODS

Freq	Transmission Medium	Area of Exploitation	Advantages		Disadvantages	
			Military	Commercial	Military	Commercial
VLF	Ground Waves	Long-Range Communications	underground use very long range	(not applicable)	low info rate extremely large ant.	
L-F	Ground Waves	Navigation	long range	long range	low info rate extremely large antennas	low info rate extremely large ant.
M-F	Ground Waves	Comm. Broadcast	(not applicable)	very simple equip. consumer education historical tradition	(not applicable)	limited bandwidth
H-F	Ionospherically Reflected Waves	SSB Voice Digital Data Double Sideband Voice Teletype	long range low-cost equip. simple mobile equip. overwater capability	long range low-cost equip. simple mobile equip. overwater capability	subject to ionospheric disturbances; limited number of channels subject to jamming need different channels for 24-hour use	ionospheric disturbances need many channels for 24-hour use limited number of channels interference
VHF	Ionospheric Scatter	Voice and Data	long range, reliable 24 channels per station privacy overwater capability high deg. of common use	long range, reliable high information rate overwater capability high degree of common use; trunk capability	subject to line-of-sight jamming; large and complex equip. fixed stations only nonlinear phase shift	complexity and cost of equip. non-linear phase shift
	Line of Sight	Mobile Communications Paging systems Ground-to-Air Systems	simple equipment small antennas	simple equip.; small antennas; low power requirement; large investment in inventory suitable for min. equip.	short range small number of channels	short range no new channels available interfreence
	Meteoric Scatter	Teleprinter and Data	long range good long-time reliability privacy overwater capability high deg. of common use of freq.	long range simple equip. good isolated area perf. good long-time reliability multiple use of freq.	subject to line-of-sight jamming poor short-term availability low average info rate fixed stations only	poor short-term availability low average info rate no voice capability needs large message storage
UHF	Line of Sight	Ground-to-Air Systems Mobile Communications	simple equipment small antennas reliable perf.; large investment in inventory	simple equipment small antennas reliable perf. miniaturized; low power	short range interference subject to jamming	short range interference
	Tropospheric Scatter	Voice, Data, Teleprinter and Video	trunk capacity; privacy medium overwater range (200–600 miles) frequent reusability of freq.; reliability suitable for long-range trunk system	trunk capacity medium overwater range (200–600 miles) reusability of freq. good reliability suitable for long-range trunk system	large equipments high power required complex equip. for ground-air use semi-permanent site	complex equip. high power required large investment
	Active Satellite Relay	Voice, Data, Teleprinter and Video	long range potential trunk good propagational reliability capable of air-to-air use real-time communications	hemispheric broadcast capability long-range trunk real-time communications propogational reliability	subject to jamming complex tracking high cost of launching requires clear channel interference inflexibility; short life	complex tracking high launch cost interference short life clear channel needed
	Passive Satellite Relay	Voice, Data, Teleprinter	long range; versatility propagational reliability real-time comm. independence from satellite limitations cheap light satellite anti-jamming capability	long range reliable real-time comm. multuple users of satellite equipment complexity on ground	complex tracking high-power gnd equip. large gnd stations	complex tracking high-power gnd equip. large gnd stations
	Line of Sight	Microwave Relay	trunk and video capability suitable for long-range network; simple equip. privacy; reliable reusability of freq.	same as military	large real estate requirements interference subject to physical interruption perm. installations	interference physical interruption large number of repeaters
	Courier Satellite	Data and Teleprinter	simple gnd equip.; reliable suitable for delayed comm.; privacy suitable for vehicle comm. anti-jamming features	simple gnd equip postal and telegram delivery system privacy reliable	high launching cost complex satellite equip. inflexibility short life not real time	high launch cost complex satellite equip
	Tropospheric Scatter	Voice, Data and Video	small equipment vehicle-to-vehicle over horizon large number of channels	small equipment vehicle-to-vehicle over geographic obstacles large number of channels	complex equip. short range per hop	complex equip. short range per hop
	Lunar Reflection	Voice or Data	available reflector; long-term reliability; precisely-known reflector location large reflecting surface	precisely-known reflector large reflecting surface	very limited availability high-power equip.	very limited availability high power equip.



G-E Five-Star tubes prove 99.11% reliable in 10,000 hour life test

Four hundred and fifty type 6829 Five-Star tubes were subjected to a DC life test to study the effects of heater voltage, heater-cathode potential and plate dissipation on vacuum tube life and reliability. After 10,000 hours of operation, failure rates were such that no statistical significance could be attached to them. Of the 450 tubes tested, only four failures occurred: two at 3000 hours, one at 3200 hours, one at 9000 hours—despite the fact that the test parameters were purposely made severe enough to produce early failures. For example, in test lot number six, 30 type 6829 Five-Star tubes were tested under severe conditions (elevated heater voltage: 6.5 volts, over 100 volts negative heater-cathode potential, 2.88 watts per plate dissipation). There were no failures at 10,000 hours. Test data supplied upon request.

In life tests such as this, and in everyday performance, G-E Five-Star tubes prove their reliability in critical applications: airborne navigation and communications, industrial controls, two-way communications, broadcast. *Five-Stars are not tubes selected from standard receiving types.* They are specially designed, specially manufactured to cope with particular electrical requirements and withstand severe environmental conditions such as shock and vibration. Where you can't afford to compromise performance and reliability, order Five-Star tubes from your General Electric tube distributor. Distributor Sales, General Electric Company, Room 7143B, Owensboro, Kentucky.

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Panel Displays Real-Time or Programmed Data

DISPLAY PANEL comprised of miniature bistable electromechanical reflective elements can be programmed to provide line displays. Area of the flat screen, which is only a few inches thick, is almost unlimited. The reflectors in a matrix arrangement can be controlled by external coordinate drive circuits. Light intensity is limited only by the external light source used, and the panel can be adapted to produce displays in color.

The display system was developed by Maico Electronics, Minneapolis, a subsidiary of W. A. Sheaffer Pen Co. The first expected application of the panel is to display military information at combat intelligence centers. Alpha-numeric characters would be displayed in black and white in this application. Coincident drive circuits would not be required to display the programmed data, which would probably reduce costs.

The panel can be digitally controlled to display information in real time. Fast-moving objects such as aircraft or missiles tracked by radar can be displayed on the panel. Composite displays such as map overlays or half-tone presentation of continuous-tone pictures are also possible. Other basic advantages claimed for the system are simplicity, reliability, relatively moderate cost and anticipated picture resolution of at least 2,000 lines.

Black and white displays are formed by individual reflectors. Color displays are produced by operating the reflectors in groups of three representing the primary additive colors red, blue and green. Combinations of reflected light from each three-color group include six colors in addition to black and white.

The basic element of the display panel is the reflective element shown in Fig. 1. A thin magnetic film at the center of the reflector is sandwitched between reflective material and colored plastics. The electromagnetic reflectors are mounted on a pivot so that they can be driven between two stable positions. At one position, light from the source is reflected toward the viewer and at the other position, it is reflected back toward the source.

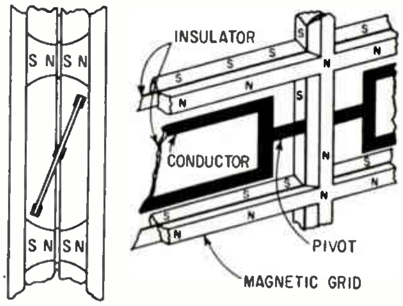


FIG. 1—Reflector in cross sectional view at left is shown mounted in magnetic grid at right

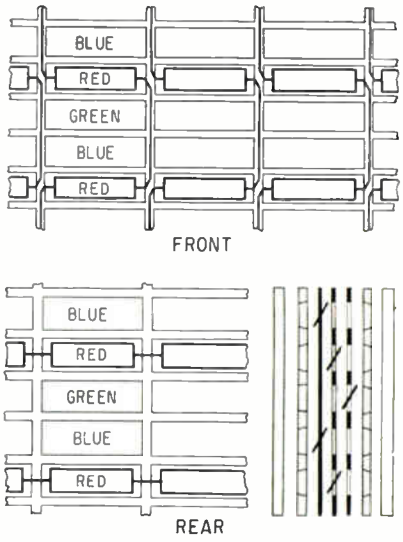


FIG. 2—Heavy lines show front and rear printed wiring for color displays. These displays are produced by panel arrangement shown in exploded side view (lower right)

The reflectors are mounted in a matrix similar to that used in computer ferrite-core memories. The grid into which the reflectors are placed provides windows for each reflector. The positioning magnetic poles are in the form of a pressed magnetic grid and are uniform on one face of the grid, as shown in Fig. 1.

The reflectors are driven in the matrix by x and y coordinate drive circuits. Single-conductor printed wiring on the front and rear of the plastic permanent magnet grid provides x- and y-axis drive power as shown in Fig. 2. The arrangement for color displays is also shown in the illustration with an exploded view of the three layers of color reflectors.

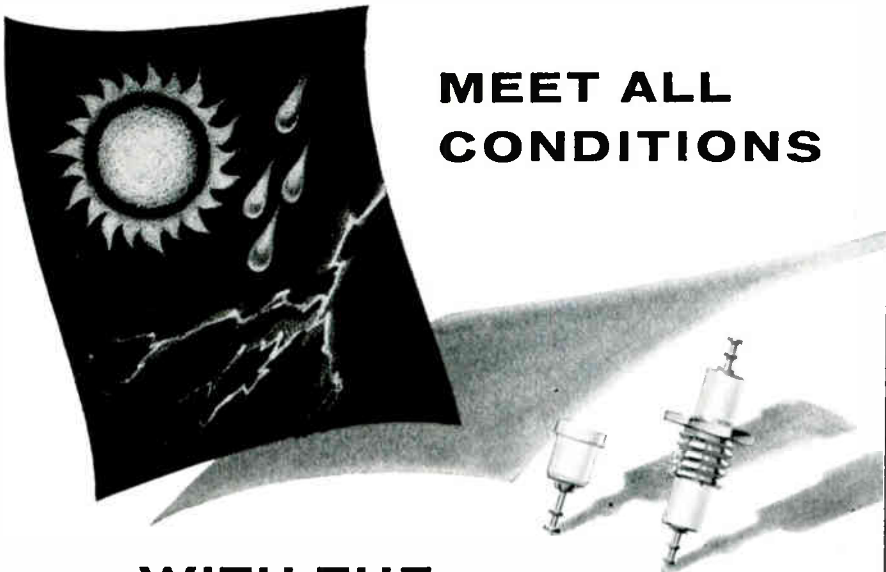
To change reflector position from one of its stable positions to the other requires simultaneous electrical impulses from both the x and y drive circuits, as in a core memory. The reflector remains at the new position even after the drive pulses have ended. The panel is erased by scanning it in the x direction with a pulse of opposite polarity. If required, a third conductor can be provided as in a conventional memory to retrieve data displayed on the panel. In addition, information can be written on the panel with a magnetic pencil, transferred back to a computer buffer memory and read out on the display again.

Drive requirements for the panel depend on reflector size, panel size and other factors. Drive current usually ranges from 500 ma to 4 amp in pulses from 1 to 10 millisec for low-speed applications. High-speed operation requires special magnetic films that are more costly to control in production but can switch at a maximum speed of 250 nanoseconds

Antennas Made for Study Of Earth's Magnetic Field

SPECIAL-PURPOSE antennas have been designed to investigate low-frequency oscillations in the earth's magnetic field. Data about these micropulsations will be collected and efforts will be made to determine how they can be related to unusual solar or magnetic activity.

The antennas were constructed by the National Bureau of Standards, which only recently started the study. Results should provide further useful information about



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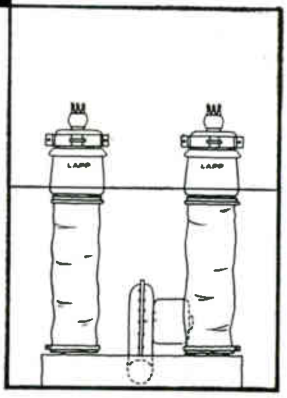


ionospheric disturbances arising from extraterrestial sources that may affect radio communications.

On the rim of each loop antenna, 130 miles of copper wire is wound in four separate channels. A layer of copper screening covers the 32,000 turns of nylon-coated wire. The entire $6\frac{1}{2}$-ft diameter antenna is then coated with fiber glass for protection and waterproofing because the antennas will be buried in the earth to prevent wind interference.

Oscillation in the earth's magnetic field can be devided into three general period groups. Major pulsations are often observed on standard magnetometer records with periods of about 1 to 3 minutes and amplitudes sometimes exceeding 10 gamma. Micropulsations with periods from 5 to 30 seconds occur with amplitudes reaching several gamma. Other fluctuations occur with periods of 0.5 to 3 seconds and amplitudes occasionally reaching one gamma, although they are less frequent.

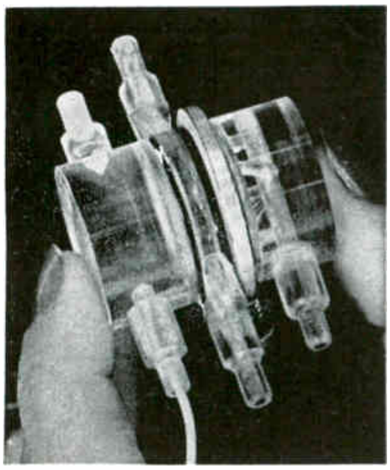
An outstanding feature of the three period groups is their nearly sinusoidal form. Also, both the characteristic periods and average amplitudes of all three groups decrease by powers of ten.

The highly sensitive antennas will be used to study ulf electromagnetic waves in the broad range of periods from 0.1 to 200 seconds. The signals now getting the most intensive study are those with periods from 5 to 30 seconds. The origin and occurrence of these micropulsations are little understood, although their existence has been know since 1861. The signals are much stronger in the auroral zones and are probably associated with the influx of primary electrons into the ionosphere after solar storms.

Permanent micropulsation installations each using one antenna are being established near Boulder, Colorado, College, Alaska, and Huancayo, Peru. Six additional antennas will equip two portable stations to measure direction of micropulsations over broad areas.

Although primary use of the antennas will be in the investigation of micropulsations, they have two other applications. The antennas will be valuable in the study of extra low-frequency sferics, the electromagnetic waves originating from lightning discharges, and the major pulsations with periods of 1 to 3 minutes, which are thought to be caused by resonance of the outer atmosphere when bombarded by charged particles from the sun.

Fuel Cells May Propel Subs of the Future



Experimental fuel cell is expected to have important future in military applications

EXPERIMENTAL fuel cell could lead to silent propulsion power for submarines or to emergency power at missile bases. The model sodium amalgam-chlorine cell that suggests these possibilities produces open-circuit output of 3.3 volts. The same cell with bromine substituted for chlorine provides 2.89 volts.

The fuel cell was described by J. S. Smatko, Hoffman Electronics, at the Power Sources Conference sponsored by the Signal Corps.

Size of the experimental cell can be increased or decreased from that of the model. When size is considered, the one watt output power provided by the model fuel cell is double that of the two-thirds watt produced by a conventional flashlight cell.

The same type power source could be designed to produce thousands of kilowatts. It is also believed that modifications of the present model fuel cell may double its power output.

Byproduct of the chemical reaction in the fuel cell when chlorine is used is high purity table salt. If bromine is used, the salt produced is one used in photographic processing and patent medicine.

Colloidal Alumina Forms Stable Thin Film

John Bugosh, of Du Pont, found that basic aluminum ions in solution can be polymerized in a controlled manner to produce colloidal particles which are not much larger than organic polymer molecules. Significance: thermal, insulating, conducting, and optical properties that suggest interesting applications for metals, ceramics, laminates and electronic components

LAST WEEK at several electronics laboratories, materials men examined samples of an aluminum oxide powder that pointed to promising applications for upgrading components, particularly for high temperature uses. Du Pont chemists who developed this material, usually restrained in the use of superlatives, indicated that this development has more unusual properties and use possibilities than any material to emerge from their laboratories in a long time. The alumina will find uses not only in electronics and missiles, but in such widely diverse areas such as textiles, paints and cosmetics.

The white, free-flowing powder, called Baymal, consists of clusters of tiny fibrils of boehmite alumina. The powder disperses readily in water to yield sols of the ultimate fibrils. The surface of the fibrils is modified by adsorbed acetate ions which play an important role in collodial behavior and the useful properties of the product.

The typical chemical composition of the collodial alumina consists of: AlOOH, 83.1%; CH_3COOH, 9.8%; SO_4, 1.7%; water, 5%; NH_3, 0.2%; Na, 0.07%; Fe, 0.02%; and SiO_2, 0.02%.

Structure dispersion to its ultimate fibril composition leads to the following properties:

A wide viscosity range, from very fluid to extremely viscous thixotropic sols. (becoming fluid when shaken).

Interlocking and chemical bonding of the fibrils produces continuous, coherent, microporous coatings.

Binding properties, which result from film-forming ability, as well as reactivity with other materials.

Polymer reinforcement, due to fiber interaction and chemical reactivity.

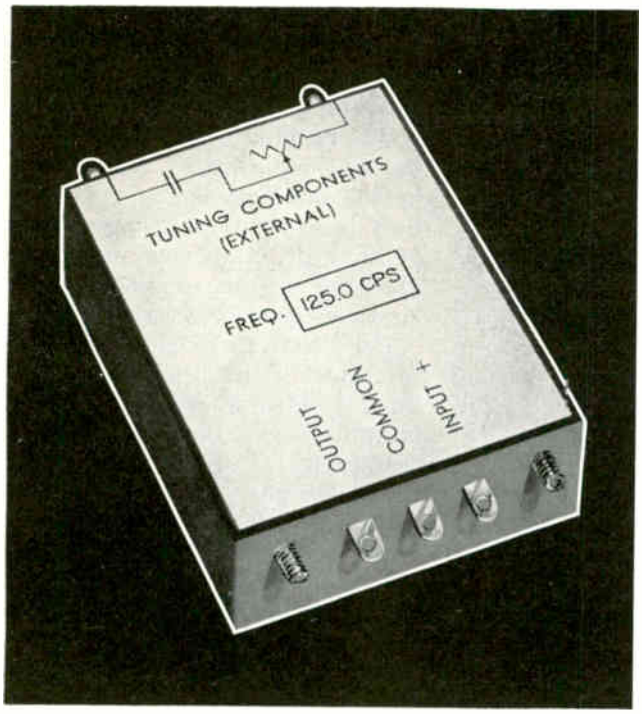
The high positive surface charge on the colloidal alumina produces rapid interaction and exhaustion onto negative surfaces. Such surface coatings will in turn anchor to other negative materials. The hydroxyl groups on the fibril surfaces react readily with carboxylic acids, proteins, and other reactive hydroxyls and form chelates.

What does this mean for improved electronics components? Although the colloidal alumina is still unexplored for specific applications, the binding and coating properties, combined with chemical inertness and high melting point, suggest a variety of electronic applications: thin-film thermal barriers; electrically conducting or insulating coatings; high-purity, high-strength insulators; upgrading thermal, abrasive and chemical resistance of components; and improved extrudability.

When a colloidal dispersion of Baymal is dried from water onto a surface, the small fibrils lie flat and interlace to form a film. Very few inorganic materials and no other alumina form films in this manner. And such films remain stable at high temperatures.

When dispersed in water, fibrils of the colloidal alumina assume a positive charge. Thus, the film can fix itself to negative surfaces, completely changing their surface charge from negative to positive. In addition, the alumina is wet both by water and certain organic liquids. The material can act as an emulsifier and a thickening, dispersing and suspending agent in both water and water-alcohol.

A dilute solution of the colloidal alumina in water assumes viscosity characteristics that are unusual. A four percent dispersion, for example, can be changed from a very fluid solution to a viscous sol or paste through a slight change in acidity. These viscous sols and pastes are highly thixotropic. In such a state, a gel remains solid until shaken or agitated, which causes it to turn into a liquid. On being allowed to stand, the liquid again becomes a solid gel. This reversible transformation can be reproduced any number of times, and the time required for the gel to set up can



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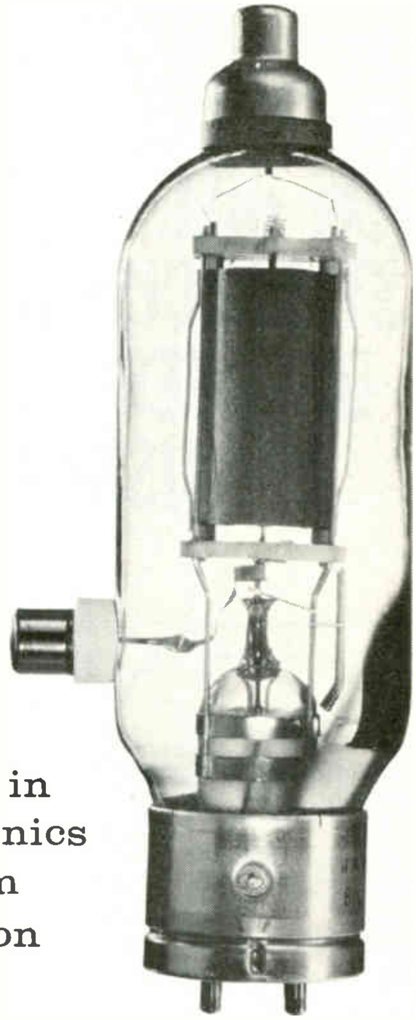

Ideas in Electronics from Norton

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This outstanding growth has been largely due to the development of new materials — *refractory* materials with a great range of electrical properties. The prime source of these *idea refractories* is Norton Company.

For example, refractory fused alumina has high constant resistivity, to assure minimum leakage between elements in TV, radio and radar tubes. The same material is a recent innovation for transistor potting. Norton silicon carbide is an essential component in lightning arrestors and other non-linear resistors because of its variable voltage-current relationship. Silicon carbide is also finding new uses in microwave absorption, and as single crystals in high temperature rectifiers and transistors.

Fused magnesium oxide, used in most heating elements for electric ranges, has gained acceptance in such areas as advanced thermocouple design and infrared transmission.

Norton offers a wide choice of super-refined refractories, including oxides, borides, nitrides and carbides, and is ready to work with you in engineering materials to meet your needs. But above all, Norton offers ideas in every field in which refractory materials play a part.

Write NORTON COMPANY, Refractories Division, 684 New Bond Street, Worcester, Massachusetts.

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be tailored from less than a second to more than a day. Materials men claim the compound to be the most thixotropic material known.

When applied to a solid substrate, the colloidal alumina forms a coherent, adherent film if the thickness is not over a few thousands of an inch. A coating on fibrous glass, for instance, makes the glass six times more heat resistant.

Dry films of the alumina, when in contact with the atmosphere at room temperature, absorb sufficient moisture so that the films are fairly conductive, on the order of a few thousands ohms per square. The dielectric loss is very high under these conditions. However, above 125 C, all the free water is evaporated, and although there is still chemically bound water present, the dielectric properties and resistivity are similar to those of asbestos.

The following values were obtained by measurement of films of Baymal ranging in thickness between 0.0007 and 0.0017 cm. The films were baked for 30 minutes at 300 C to drive off physically absorbed moisture and acetic acid. At this point the crystal structure is still boehmite, AlOOH. Measurements were then taken on a bridge holding sample at 150-170 C:

At 170 C	Av Values
Resistivity, d-c	2×10^9
Diel const, (1,000 cps)	10
Diss fact, (1,000 cps)	0.2

The film-forming ability of Baymal makes it useful as an inorganic, high-temperature adhesive. A low-density, heat insulating block of aluminosilicate fibers bonded with the alumina and then heated to 2,000 F, is still well bonded.

The fibrillar particles present in the colloidal alumina are about 1,500 Angstroms long and 50 Angstroms in diameter. There is no known way of grinding alumina to particles of this size.

Dense, highly refractory corundum bodies can be made from the alumina powder by simultaneously applying high temperatures and high pressure. Metal cutting tools can be made in this way.

The colloidal alumina also has curious optical properties. When a dilute dispersion of the alumina in a narrow vial is rotated between polarizing screens, a distinct cross can be seen. This is the so-called cross of isocline, and the phenomenon is called streaming bifringence. By the exact measurement of the position of the arms of this cross, the dimensions of the particles in solution can be determined. At higher concentrations striking bifringent colors are produced.

The colloidal alumina is not in commercial production, but one-pound samples are available for initial laboratory work.[1] Up to 50-lb lots have been offered for trials in promising applications.

REFERENCE

(1) Ralph K. Iler, Manager, Pioneering Industrial Chemicals Research, Industrial And Biochemicals Dept., E. I. du Pont de Nemours and Co., Wilmington, Delaware.

Micron-Thin Teflon Now in Production

A NEW MICRON-THIN Teflon dielectric capacitor film, called Glofilm, is now available on a limited production basis from Radiation Research Corp., Westbury, Long Island, N. Y.

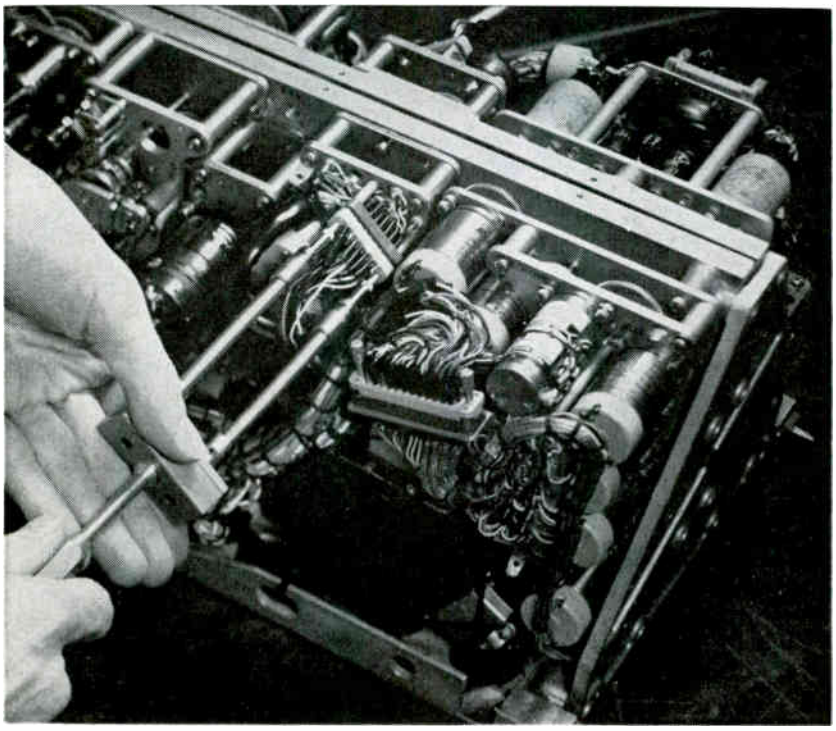
The new film has been in development for the past three years. Named for its characteristic method of manufacture, the film utilizes the direct polymerization of fluorocarbon monomer (Teflon) on a ¼ mil metallized Mylar substrate under vacuum in a high frequency glow-discharge.

For use in transistorized circuits, subminiature electrostatic capacitors wound with the film are 25-75% smaller by volume than standard capacitors, including 0.00025-in. Mylar, Teflon, or 0.0002-in. impregnated paper, either metallized or foil construction.

The ¼ mil metallized Mylar substrate which serves only as mechanical carrier of the vapor-deposited zinc or aluminum electrodes and overlaying deposit of pin-hole-free micron-thin Teflon dielectric, permits the high speed winding of capacitors while using conventional winding equipment and techniques. Pig-tails or leads are attached using normal metal spray methods prior to final encapsulation.

Although the Mylar substrate limits maximum continuous operation to 125 C, the micron-thin Teflon dielectric retains its full voltage and high insulation properties over the entire range.

Dual Screwdriver Prevents Connector Cracking



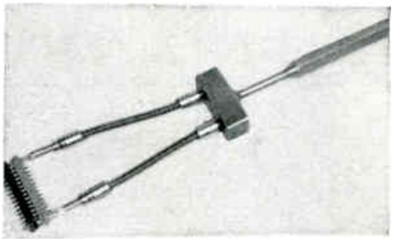
Driver tightens or loosens both connector screws at once

By LEON T. DOURGARIAN,
Production Engineer, Kearfott Div.,
General Precision, Inc., Little Falls, N.J.

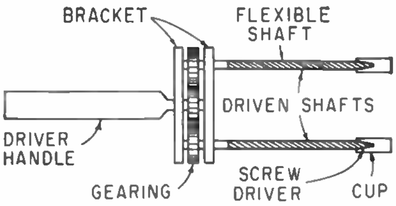
DUAL SCREWDRIVER, by simultaneously turning both mating screws of multipin connectors, solves a reliability problem and reduces connection and disconnection time to a fraction of that formerly required. The same screwdriver can be used on a variety of connector sizes.

Kearfott uses a large number of miniature molded connectors in its analog computer and servo components and systems. Most of these systems must operate under severe environmental conditions. Testing and field reports indicated that some connectors were failing under high and low temperatures, vibration and mechanical shock, due to cracking of the molded plastic around the pins.

Visible cracks or breaks are easily discovered and can be rectified immediately. Hairline cracks are difficult to spot, even under high magnification. If undetected, they can cause field failures under certain environmental conditions.



Flexible shafts adapt drivers to a variety of connector sizes



Gearing turns both screwdrivers at same speed

Besides field and testing failures, time lost in replacing connectors with visible cracks had become a continuous source of trouble to the production department. It takes a wireman about two hours to unwire and rewire a 50-pin connector, which must then be reinspected electrically and mechanically.

Investigation revealed that the problem was not caused by the connector itself, but by the method of mating the male and female sections. With a regular screwdriver, the technician alternately tightened the screws at each end of the connector, a few turns at a time. He tightened (or loosened, for disconnection) each screw about five times to mate the connectors securely.

If one screw was turned more than three or four turns, the mating connector became cocked, causing stresses which led to hairline cracks in the molded material.

The dual screwdriver was developed to reduce this human element. Dual driver shafts are connected through gearing to a single driving handle. Adding flexible driver shafts enables the tool to handle various sizes of connectors, from 14-pin to 50-pin.

In addition to preventing cocking, the tool simplifies and speeds up the operation. The driver heads are mated with each screw only once, instead of the five or six times formerly required.

Rejected P-C Boards Make Solder Masks

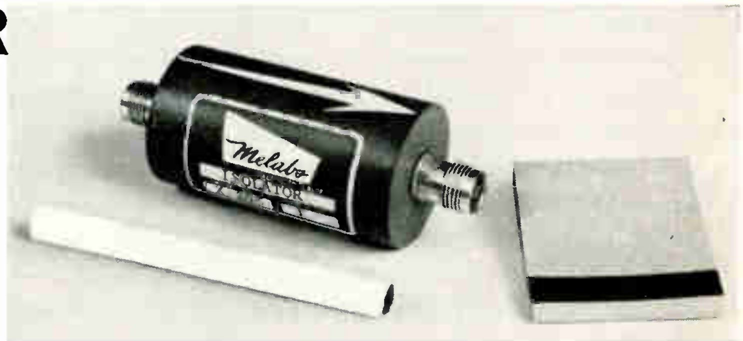
REJECTED BOARD BLANKS can be used as masks for selective dip-soldering of printed wiring board assemblies. Electronic Associates, Inc., Long Branch, N. J., reports that glass-based laminate masks can be used several hundred times and actually improve after "aging" in hot solder.

A rejected board is selected from the same run as those used in the assemblies being soldered. Component insertion holes are enlarged with a drill the size of the wiring pads or lands.

Dross is cleared from the solder and the mask floated on the cleared area. The operator takes an assembled, prefluxed board and puts light up time...

AND TIME TO LIGHTEN UP!

An ISOLATOR



only 4 ounces light! Only 3½" long, including connectors!

Your every isolator problem involving size and weight is solved with this Melabs Model X-205: 5.4 to 5.9 GC • max. insertion loss (at band ends) 1.0, typical center, 0.8 • isolation (min. at band ends) 18.0 (typical center, 25.0) • input VSWR max. 1.25:1 • power, 5 W av. • TNC connectors —all this... and magnetically shielded!

Delivery, specified quantities, available from stock: Melabs X-205 Isolator, $320.00.

Data subject to change without notice. Price f.o.b. factory

Ambitious engineers are offered unlimited opportunities for career advancement at Melabs. Write today.

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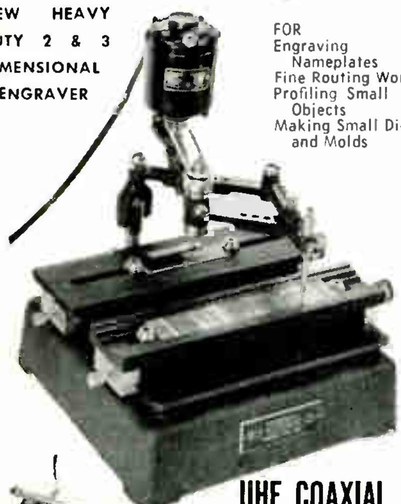
CIRCLE 204 ON READER SERVICE CARD

MICO *Precision Apparatus*

NEW HEAVY DUTY 2 & 3 DIMENSIONAL ENGRAVER



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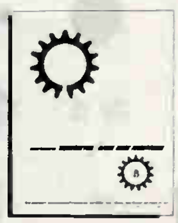
77 Trowbridge St. Cambridge 38, Mass.

CIRCLE 220 ON READER SERVICE CARD

WHAT'S YOUR TRANSISTOR COOLING PROBLEM?

Whatever it is, you can probably find the solution with a Birtcher Radiator. Available in sizes and designs to most efficiently cool all popularly used (and many special) transistors. Test reports show up to 27% more transistor efficiency!

AVAILABLE FROM AUTHORIZED BIRTCHER DISTRIBUTORS



NEW!
TRANSISTOR RADIATOR CATALOG 1–HR

Just off the press – write for it

THE BIRTCHER CORPORATION

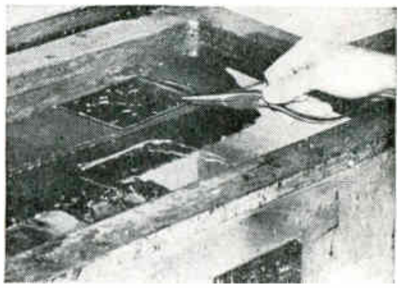
INDUSTRIAL DIVISION

745 S. MONTEREY PASS ROAD, MONTEREY PARK, CALIFORNIA

CIRCLE 77 ON READER SERVICE CARD

it on the mask, lining up the edges by eye. The assembly is pushed down until the solder rises in the holes in the mask. Since a strong push is required to lower the mask, an experienced operator can tell by feel how deep to push the assembly. The dipping cycle is timed at about four seconds by a timer alarm.

After the mask has been on the



Operator places mask on cleared solder surface. This mask is blackened after long use

Assembly is placed on floating mask, with board and mask edges mating

solder for a few minutes, it becomes limp. This allows it to hug the underside of the assembly and prevents bridging of wiring paths. Since limpness is desirable, masks can be used until they begin to disintegrate. EAI cleans the masks in flux solvent after each production run and keeps them on file for future use.

When a mask is being used steadily, there is generally no need to wipe dross. Flux on the boards being soldered melts and drips into the mask holes. Normally, flux dropped on molten solder races about erratically, clearing wavering paths in the dross. In this case, the flux is trapped in the mask holes and keeps the exposed solder shiny. Dross is allowed to remain over the rest of the pot, conserving solder by retarding further oxidation. Should dross form in the holes or flux build up excessively, the operator lifts the mask and clears the surface.

Unusual Metalworking Techniques Reviewed

UNUSUAL METAL-FORMING and machining techniques are reviewed and referenced in two memoranda prepared by the Defense Metals Information Center, Batelle Memorial Institute. The publications are now available through the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

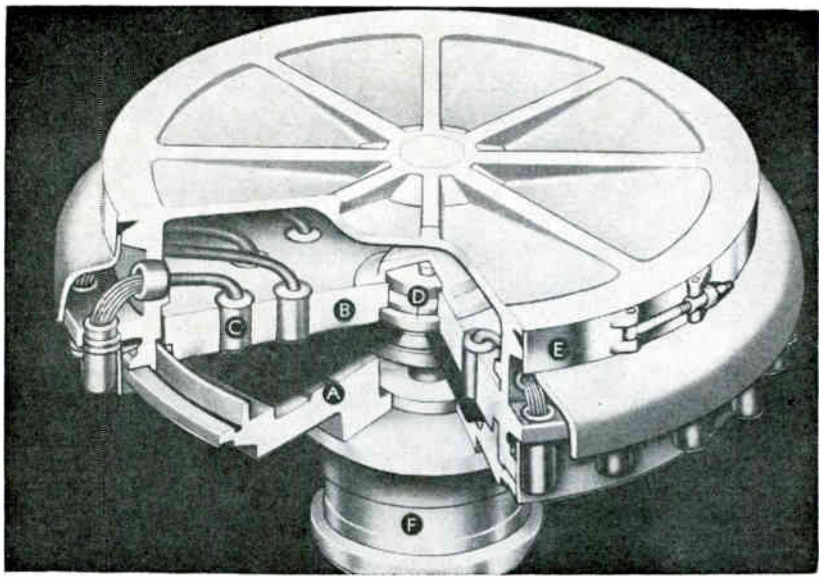
Review of Some Unconventional Methods of Machining (OTS PB 161225) surveys electrical-discharge machining, electrolytic grinding and machining, chemical milling, ultrasonic machining, electron-beam machining and plasma-arc cutting. The section on discharge or spark machining is well-detailed, including tables on machinability of various metals, electrode-material combinations and tool wear ratios. The other sections give sufficient information to evaluate them as solutions to problems in machining difficult materials.

Explosive Metalworking (OTS PB 161221) details the various explosive and explosive-hydraulic techniques of forming metal. Information on metal powder compacting, welding, cutting, surface hardening, punching and other applications is included. More recent variations which employ capacitor discharge as the energy source, rather than an explosion, are not reviewed.

Audio-Visual Assembly Aid

New entry in the growing field of audio-visual assembly aids is this synchronized unit offered by LaBelle Industries, Inc., Oconomowoc, Wis. It consists of a 35-mm color slide projector and cartridge tape recording player with earphones

New On The Market



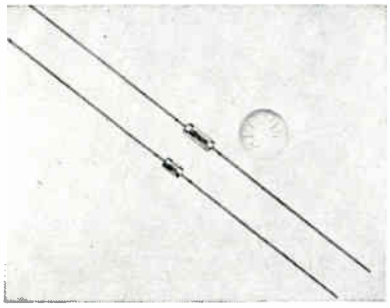
Bernoulli Disk Memories

TO 2 MILLION BITS

TWO BERNOULLI DISKS are small, low-cost units with disks of Mylar magnetic recording tape that are spun between a read/write backplate and a stabilizing plate.

Model BD-500 has basic capacity of 500,000 bits, which can be doubled to one-million bits by adding a second disk and head assembly. This capacity can be redoubled with recording techniques. Model BD-200 has basic capacity of 200,000 bits, which can be doubled to 400,000 bits and redoubled to 800,000 bits. Memories can be mounted in any orientation and are available as bench units. Manufacturer is Laboratory For Electronics Inc., 1079 Commonwealth Ave., Boston, Mass.

CIRCLE 301 ON READER SERVICE CARD



Carbon Film Resistors

MINIATURES; $\frac{1}{10}$ AND $\frac{1}{8}$ W

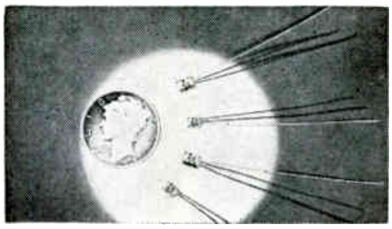
TWO CARBON film resistors: PT30 is rated $\frac{1}{10}$ watt and is 0.156 inch long by 0.09 inch in diameter; PT55, rated $\frac{1}{8}$ watt, is 0.281 × 0.09 inch and meets or exceeds all RN55 MIL Specs.

Resistors are hermetically sealed in borosilicate envelope.

Tolerances are ±1.0 percent, voltage coefficient is less than 0.0002 percent per v, temperature coefficient is −0.02 to −0.05 percent per deg C; weldable leads are tinned, copper clad, and welded to the end caps.

Manufacturer is Pyrofilm Resistor Co. Inc., Box 1521, U. S. Highway 46, Parsippany, N. J.

CIRCLE 302 ON READER SERVICE CARD



Miniature Transistors

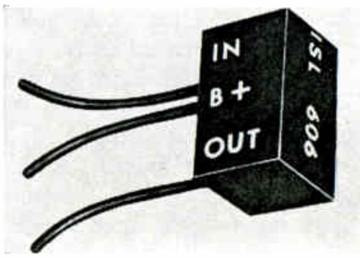
PNP GERMANIUM ALLOY

MINIATURE *pnp* germanium alloy transistors R-2 and R-3 are 0.16 × 0.13 and 0.13 × 0.1 inch, respectively. For audio or i-f amplifiers, they have noise factor of 5 db max, betas exceeding 300, and can dissipate 30 mw at 25 C.

Applications of the hermetically sealed units include hearing aids, radios, telemetering devices, computers, data processing equipment, control systems, missile and rocket systems. Alpha frequency cut-offs are 1 and 2 Mc. Break-down voltages are −30 volts for collector to base or emitter to base, and 15 volts for collector to emitter.

Prices start at $1.90; manufacturer is Rauland Corp., a Zenith subsidiary, 6001 W. Dickens Ave., Chicago 39, Ill.

CIRCLE 303 ON READER SERVICE CARD



Low-Noise Preamplifier

LOW-LEVEL TRANSDUCERS

MINIATURIZED, solid-state preamplifier, designed for use with ir photoconductors and other low-level transducers has been announced by Infrared Industries, Inc., Waltham, Mass. The model ISL 606 operates with 1.1 to 1.8 db noise, or less, from −40 to +100 C, can be modified to further reduce noise by 0.5 db.

Specifications include: input impedance of 1.0 megohm or 10 megohms; output resistance of 2,000 ohms; power drain of 0.18 ma at 10 v; size is less than one cubic inch. The preamplifier can be modified for very low temperature operation and to meet military specifications.

CIRCLE 304 ON READER SERVICE CARD

Spectrum Analyzer

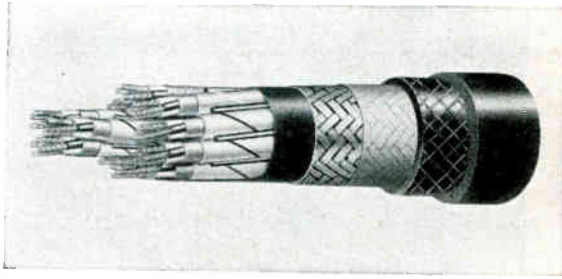
RADAR DETECTION

INCREMENTAL power-spectrum analyzer supplies an automatic plot—a continuation of power against frequency—for radar detection, electronic counter-countermeasures and rfi studies. Instrument gives

3 Ways General Electric Helps You...

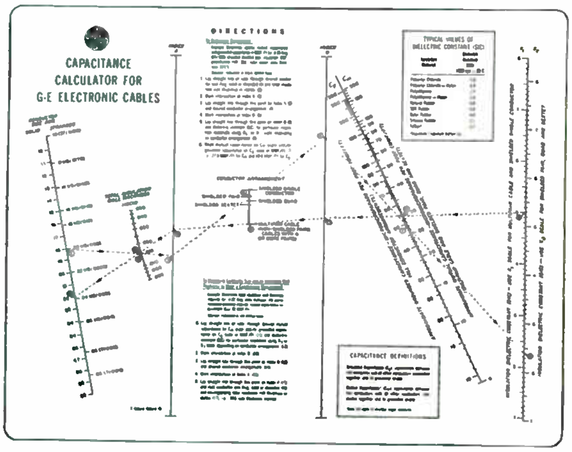
Meet Multiconductor Cable Applications for ELECTRONIC EQUIPMENT AND SYSTEMS

1 COMPREHENSIVE CABLE DESIGNS



General Electric can furnish the custom-designed electronic multiconductor cable you need . . . in a variety of constructions and combinations of thermoplastic, thermosetting, and Teflon insulations and jackets. G-E engineers can design cable to meet Government specifications, customer specifications, or a particular application. This design capability results from years of experience in systems engineering in radar, missiles, data processing, and other electronic applications, as well as in wire and cable.

2 TIME-SAVING CAPACITANCE CALCULATOR



General Electric's new, easy-to-use Capacitance Calculator will save you time in estimating cable capacitance or conductor size and/or insulation wall thickness to meet capacitance requirements. The calculator is made of laminated acetate for long wear, and comes complete with see-through plastic ruler.

3 EXPERT APPLICATION ASSISTANCE

General Electric Wire and Cable specialists are ready to provide complete information and show you samples of many types of G-E multiconductor cables. They are also available to help with technical assistance in cable application or design.

For your free G-E Capacitance Calculator and the name of the G-E Wire and Cable specialist in your area, write over your company letterhead to: General Electric Company, Wire and Cable Dept., Section 601-1, Bridgeport 2, Conn.

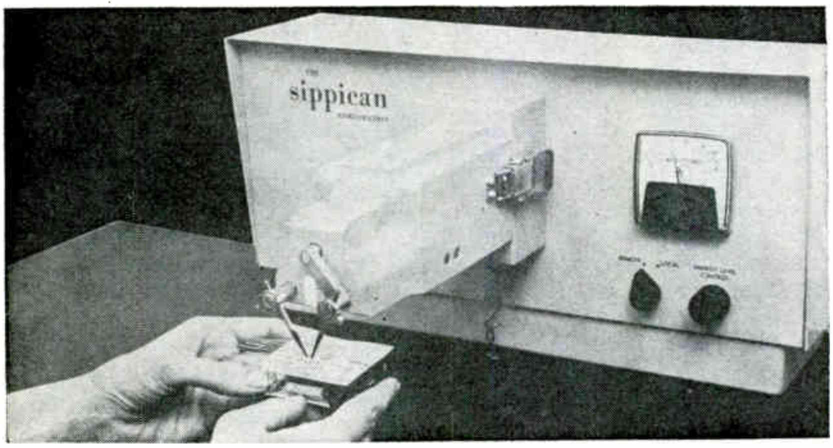
GENERAL ELECTRIC

instantaneous direct readings of r-f power and frequency at laboratory accuracies.

Any two of 125 fixed-tuned, narrow-band video channels may be chosen as extra bright dot frequency markers on scope pattern. Power measurement accuracy is ± 5 percent and frequency resolution is 5 Mc for inputs from one to 50 watts per Mc.

Instrument covers S-band from 2,400 to 3,600 Mc; L-band unit will be available soon and full line will span 50 to 12,400 Mc. Size in inches is 1¼ by 15¼ by 21½; weight is 98 lb. Two enclosures are available, one for military aircraft and one for commercial use. Manufacturer is Hallicrafters Co., 4401 W. 5th Ave., Chicago 24, Ill.

CIRCLE 305 ON READER SERVICE CARD



Precision Welder

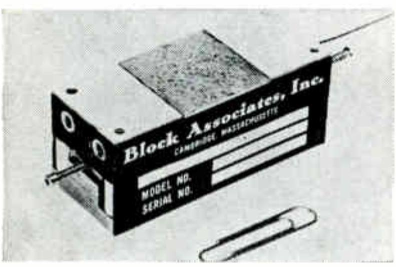
INTERCHANGEABLE HEADS

WELDER ALLOWS precise control of machine variables in the fabrication of welded electronic assemblies. No adjustment of electrodes, heads or power settings is required. Foot pedal pressure and rate of motion have no effect on the quality of the weld.

The welder has plug-in heads (both vertical and pincer designs). Energy storage is 0.4 to 40 watt-sec and pulse width, 1 to 1.25 msec. Both weld heads permit preset pressure and energy adjustments. Compatible accessory equipment, including miniature electrodes, film punch, hand tools and pressure gage, are available.

Price of welder is approximately $950, delivery in June, from the Sippican Corp, Marion, Mass.

CIRCLE 306 ON READER SERVICE CARD



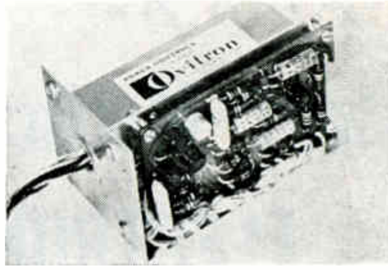
Linear Actuators

HIGH FORCE, HIGH SPEED

HIGH FORCE linear actuator is not a solenoid but a biased moving iron transducer where the moving element is displaced perpendicularly to the magnetic lines of forces. This permits a linear relation between force and both current and displacement. Available force is about ten times larger than for a comparable solenoid and speed is ten times faster.

Applications include linear motions for shake tables, fatigue testing, large displacement valves and vibration sorting equipment. Specifications of BM-02 include: force (push-pull) of 3 lb, time constant of 5 msec, stroke of $\frac{3}{16}$ inch, power requirement of approximately 30 watts. Manufacturer is Block Associates, 385 Putnam Ave., Cambridge, Mass.

CIRCLE 307 ON READER SERVICE CARD



Magnetic Trigger

AND PREAMPLIFIER

FAIL-SAFE magnetic phase-control amplifier and all silicon transistor preamplifier triggers thyratrons, controlled rectifiers and other switching elements.

The trigger and p-c board preamplifier are available separately or assembled. Signal input for full thyratron power output is less than 5 mv a-c into 10,000 ohms. Triggering output has steep wavefront whose phase varies with signal input amplitude; output peak power is 250 mw. In temperature control models a shielded output winding and an a-c voltage regulator to excite a resistance bridge are included. For thyratrons, a bias output is provided. Price of complete assembly is $139 in moderate quantity, from Ovitron Corp., 105 River Rd., Cos Cob, Conn.

CIRCLE 308 ON READER SERVICE CARD

Decade Inductors

PRECISION UNITS

SPRAGUE ELECTRIC CO., North Adams, Mass., announces precision decade inductors for design and experimental work on audio filters, equalizers, and tuned circuits in the frequency range of 150 to 20,000 cps. Four standard boxes include decade inductors with 10 steps of

CIRCLE 83 ON READER SERVICE CARD→

0.001 henry each, 10 steps of 0.01 henry each, 10 steps of 0.1 henry each, and 10 steps of 1 henry each.
CIRCLE 309 ON READER SERVICE CARD

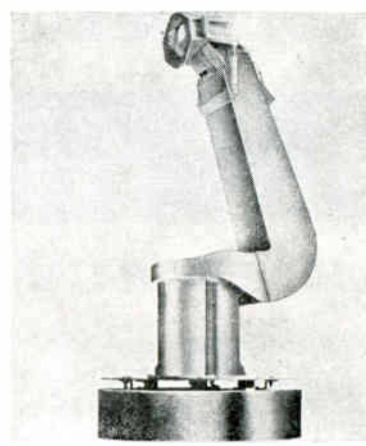
Low Capacitance Diode
FOR FAST SWITCHING

HERMETICALLY sealed miniature glass diode that is especially applicable for fast switching applications has been developed by United Components, Inc., 105 Lincoln Ave., Orange, N. J.

Type UCI-362 has shunt capacitance of 1 pf, is designed for switching in the nsec range. It meets all military requirements for mechanical and environmental conditions.
CIRCLE 310 ON READER SERVICE CARD

Printed Circuit Cleaner

NATIONAL ULTRASONIC CORP., 95 Park Ave., Nutley, N. J. System cleans printed circuit boards with mounted components, removes both activated and nonactivated fluxes.
CIRCLE 311 ON READER SERVICE CARD

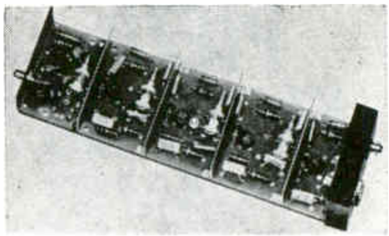


Antenna Mount
MINIMUM INERTIA

TEMEC. INC., 7833 Haskell Ave., Van Nuys, Calif. Designed for ground based or shipboard application, model 11 antenna pedestal and tracking servo system combines high performance, minimum weight and low cost. It positions array type antenna systems that require high angular velocity and acceleration characteristics. It can accommodate antenna arrays up to

12 ft in height through angles of depression as great as 15 deg.

CIRCLE 312 ON READER SERVICE CARD



Post I-F Amplifiers
TRANSISTORIZED

ORION ELECTRONIC CORP., 108 Columbus Ave., Tuckahoe, N.Y. Models A106-108 silicon transistorized post i-f amplifiers are capable of −125 C operation and storage up to 150 C. The incorporated components meet requirements of appropriate military specs. Units have a center frequency of 30, 45 or 60 Mc, a 60 db gain, bandwidth of 9 Mc.

CIRCLE 313 ON READER SERVICE CARD

Universal Jig
FOR TUNNEL DIODE STUDY

TEXAS INSTRUMENTS INC., P. O. Box 6027, Houston 6, Texas, has introduced a universal jig for use with its tunnel diode curve tracer. It will accommodate any tunnel diode configuration or commercial package now available. Selling for $35, the universal jig offers improved reliability through clip-type loading and epoxy encapsulation.

CIRCLE 314 ON READER SERVICE CARD

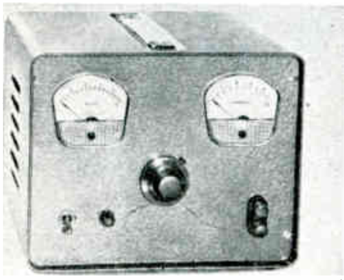
TV Film Camera

AMERICAN MICROWAVE & TELEVISION CORP., 1369 Industrial Rd., San Carlos, Calif. Vidicon broadcast tv film camera provides film reproduction

of 800-line horizontal resolution in the center with 50 percent response.
CIRCLE 315 ON READER SERVICE CARD

Microwave Ferrite
HIGH PHASE SHIFT

IRVAN ENGINEERING CO., INC., 13856 Saticoy, Van Nuys, Calif. Type 1-101 manganese magnesium ferrite compound is a versatile product for use in devices requiring a high phase shift and low insertion loss in the medium power range such as isolators, phase shifters, and the like.
CIRCLE 316 ON READER SERVICE CARD

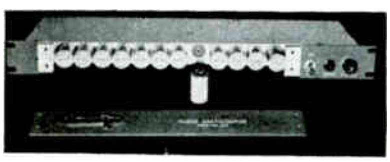


D-C Power Supplies
LOW-VOLTAGE

DYNEX INDUSTRIES, INC., 123 Eileen Way, Syosset, N. Y. Model PS120 provides low voltages for transistorized circuits, strain gages, etc. With an input of 105-135 v a-c, output is 0-10 v d-c, current 0-1 amp. Regulation is 0.002 percent for 10 percent line voltage change and 0-200 ma load current; ripple, 1 mv rms at 1 amp max; weight, 7 lb; size, 8¾ by 10½ by 8 in.
CIRCLE 317 ON READER SERVICE CARD

Power Supply

CALMAG, 11922 Valerio St., North Hollywood, Calif. Output regulation of 50,000 v laboratory power supply is 0.005 percent at 50 Kv.
CIRCLE 318 ON READER SERVICE CARD



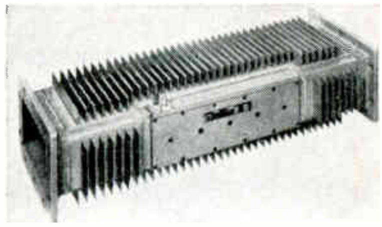
Audio Multicoupler
TRANSISTORIZED

ORTRONIX, INC., P. O. Drawer 8217, Orlando, Fla. Model 5102 audio

CIRCLE 378 ON READER SERVICE CARD

multicoupler offers simplified maintenance and low replacement cost of modules. Transistorization permits a 4X size reduction over v-t type units. The multicoupler has manifold applications. For example, it can be used for taking one telephone line and splitting the circuit into 10 other balanced outputs without loss of sound level and with over 60 db isolation between channels.

CIRCLE 319 ON READER SERVICE CARD



High Power Couplers
WAVEGUIDE-TO-STRIPLINE

GENERAL MICROWAVE CORP., 47 Gazza Blvd., Farmingdale, N. Y. Type 703 and 704 series of uni- and bi-directional waveguide-to-stripline couplers are capable of operating over a full waveguide bandwidth. Designed for MIL system applications where size and weight are critical, these couplers feature stripline outputs—eliminating the spacial requirements and the weight factors introduced by the use of conventional auxiliary arms.

CIRCLE 320 ON READER SERVICE CARD

Air Clutch

ELM INSTRUMENT CORP., 30 Chasner St., Hempstead, L. I., N. Y. Size 11 miniature air clutch provides 318.4 inch-ounces of torque output.

CIRCLE 321 ON READER SERVICE CARD

Quartz Oscillator
HIGHLY STABLE

HEWLETT-PACKARD CO., 1501 Page Mill Road, Palo Alto, Calif. Model 103AR has a long-term stability of

You Can Machine It! Mill, drill, tap, grind, form, or turn it . . . Rexolite machines smoothly, evenly, with precision! It's ideal for hundreds of different applications because you can design it into just about any mechanical shape. Rexolite is available in sheets or rods.

Radiate It! The tensile, impact and especially dielectric properties of Rexolite are not affected by radiation . . . and this is important, because ionizing radiation is becoming a common environmental hazard for the electronic equipment you design.

Load It! Under a range of loads from 10 psi to 2000 psi at temperatures from 20°C to 200°C, Rexolite 1422 will not exhibit permanent plastic flow.

And, Have Dielectric Stability, Too! An ultra-high frequency insulation material, Rexolite 1422 has a wide range of electrical advantages . . . low dielectric constant, low dissipation factor, and high dielectric strength over a wide frequency range! **To Give New Line To Your Design — Send For These Free Bulletins!**

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DIVISION OF American ENKA Corporation
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TELEPHONE: EMERSON 9-9630

Vinyl, Teflon, Polyethylene, Nylon Wire and Cables, Electrical Tubing and Sleeving — UHF Cast Plastics.

Gentlemen: Please send the bulletins on Rexolite 1422 that I have checked below:

Name .... Title ....

Company ....

Street ....

City .... Zone .... State ....

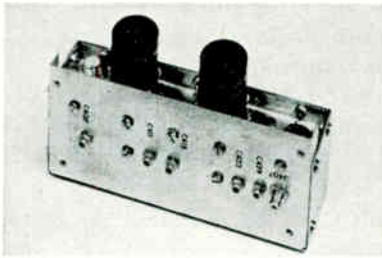
................Machining Rexolite ....Rexolite Deformation Under Load

................Rexolite Radiation Report ....Rexolite Dielectric Properties

Rexolite 1422 is another member of the growing Rexolite family of dielectrics.

5 parts in 10^{10} per day. Typical short-term stability, averaged over 1-sec intervals, is 1 part in 10^{10} when unit is operated in a reasonably constant environment. Unit provides two sinusoidal output signals, 1 Mc and 100 Kc, from a low source impedance at a power level well suited for distribution over 50-ohm systems. Price is $2,500.

CIRCLE 322 ON READER SERVICE CARD



VHF Preamplifier
BROADBAND

LEL, INC., 75 Akron St., Copiague, N. Y. Model RF75 is a wide-band r-f preamplifier for use in low noise receiving systems. Sufficient gain is provided to overcome the noise contribution of a following main amplifier. Center frequency is 160 Mc; bandwidth, greater than 75 Mc ± 1 db; gain, greater than 15 db; noise figure, less than 6 db; input and output impedance, 15 ohms.

CIRCLE 323 ON READER SERVICE CARD

Potentiometer
HIGH RELIABILITY

CLAROSTAT MFG. CO., INC., Dover, N. H. Series 57EM is a ½-in. pot featuring glass-sealed terminals. It is a wire-wound 2.0-w unit available in resistance up to 100,000 ohms. Pot is encased in a metallic housing. Resistance linearity is of the order of 2 percent. Unit is derated to zero at 150 C. It meets applicable sections of MIL-R-19, MIL-R-12934 and MIL-R-27208.

CIRCLE 324 ON READER SERVICE CARD

Literature of the Week

POWER SUPPLY Dressen-Barnes Electronics Corp., 250 North Vinedo Ave., Pasadena, Calif. Handbook includes over 200 power supplies and a procedure for the calculation of packaging dimensions for multiple d-c outputs.
CIRCLE 325 ON READER SERVICE CARD

FACILITIES BROCHURE Ohio Semiconductors, 1205 Chesapeake Ave., Columbus 12, Ohio. "The Image" describes the products and capabilities of the company.
CIRCLE 326 ON READER SERVICE CARD

SILICON RECTIFIERS Slater Electric Inc., 45 Sea Cliff Ave., Glen Cove, L. I., N. Y. A series of data sheets feature hermetically sealed, miniature diffused junction rectifiers.
CIRCLE 327 ON READER SERVICE CARD

TRANSFORMERS PCA Electronics Inc., 16799 Schoenborn St., Sepulveda, Calif. A review of data-pulse transformers and related technical data is presented in an 8-page catalog.
CIRCLE 328 ON READER SERVICE CARD

DIGITAL COMPUTER Ferranti Electric Inc., Industrial Park No. 1, Plainview, L. I., N. Y. News bulletin describes the application in Britain of a digital computer control to the operation of a boiler plant.
CIRCLE 329 ON READER SERVICE CARD

COAXIAL SWITCHES RF Products, 33 East Franklin St., Danbury, Conn. A summary of 125 standard switches is provided in a 28-page brochure.
CIRCLE 330 ON READER SERVICE CARD

RELAYS Allied Control Co. Inc., 2 East End Ave., New York 21, N. Y. Data bulletin features circuit diagrams, chassis layouts and a socket guide for military and commercial "cradle" relays.
CIRCLE 331 ON READER SERVICE CARD

CAPACITORS Corson Electric Manufacturing Corp., 540 39th St., Union City, N. J. Catalog tells how glass encased, high voltage d-c capacitors are used continuously at 85 C for 10,000 hours.
CIRCLE 332 ON READER SERVICE CARD

MICA Electronic Mechanics Inc., 101 Clifton Blvd., Clifton, N. J. Catalog illustrates fabrication and application of glass-bonded mica substrates and printed circuits.
CIRCLE 333 ON READER SERVICE CARD

RESISTORS Ortho Precision Resistors Inc., 7 Paterson St., Paterson 1, N. J. Six-page catalog reviews the company's line of miniaturized wire wound resistors.
CIRCLE 334 ON READER SERVICE CARD

BANDPASS FILTER Ad-Yu Electronics Lab., Inc., 249 Terhune Ave., Passaic, N. J. A continuously variable bandpass filter is described in a single data sheet.
CIRCLE 335 ON READER SERVICE CARD

POTENTIOMETER Reon Resistor Corp., 155 Saw Mill River Rd., Yonkers, N. Y., has published a bulletin on a 3-w composition potentiometer.
CIRCLE 336 ON READER SERVICE CARD

SILICONE General Electric Co., Waterford, N. Y. Eight-page catalog covers silicones and their uses, including a selector guide for silicone rubber.
CIRCLE 337 ON READER SERVICE CARD

AMPLIFIER Quan-Tech Laboratories, Inc., Boonton, N. J. Brochure tells how sensitivity limits are extended by a transistorized, low-noise amplifier.
CIRCLE 338 ON READER SERVICE CARD

ELECTRON TUBES Raytheon Co., 55 Chapel St., Newton 58, Mass. Bulletin describes gas and vapor electron tubes for industrial and military applications.
CIRCLE 339 ON READER SERVICE CARD

FLEXIBLE COAX CABLE Andrew Corp., P. O. Box 807, Chicago 42, Ill., has published a 16-page catalog on Heliax, a flexible air dielectric coaxial cable.
CIRCLE 340 ON READER SERVICE CARD

JACK & HEINTZ JOINS THE SIEGLER CORPORATE FAMILY!

J&H
SIEGLER

The progressive Jack & Heintz organization, now manufacturing the most complete range of electric power systems and components available from a single source, further widens the broad range of outstanding capabilities available through Siegler. ■ In Variable-Speed Constant-Frequency generating systems, the all-electric system developed by Jack & Heintz far surpasses conventional generating systems, in missiles, ground power and electric traction for special purpose military vehicles. ■ In power packages for business/executive aircraft the self-contained automatic power units developed by Jack & Heintz are equipment of choice for modern transport aircraft, including the Lockheed Jet-Star and the Aero Commander. ■ In customized motors, the new Division has removed the limits in product designing. Jack & Heintz ability to develop motors to perform required design function ranges from modification to complete new motor design. ■ In fluid couplings, Jack & Heintz offers the finest line of quick-connect couplings available, plus outstanding new coupling design capability.

Siegler resources will be able to extend even further the development of the new Jack & Heintz facility—assuring accelerated progress for the new Division into new product fields, and providing increased service to Siegler customers. For further information call or write The Siegler Corporation.

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CIRCLE 95 ON READER SERVICE CARD

Goldsmith: as plants blew up . . .

IT'S A BIG JUMP from firecrackers to satellites . . . 66 years to be exact, and Essex Electronics division of Nytronics, Inc., is the jumper.

While Nytronics, unlike its predecessor, Essex Specialties Co., no longer makes explosives, its explosive growth may be attributed to the guidance since 1939 of its youthful president, Bernard M. Goldsmith.

The firm started out (in Newark, N. J.) in the rocket business and is in a sense still in it. The difference, though, is that the old Essex Specialties Co. was one of the nation's leading makers of Fourth of July firecrackers, cherry bombs, rockets and the like.

Today its descendant in Berkeley Heights no longer makes explosives, but its line of coil devices and controls, such as its trade-marked Wee-ductors, have been in almost every rocket and satellite launched so far.

Goldsmith has an easy explanation for the movement in stages of the firm's activities away from Newark. "As plants blew up," he grins, "we moved further and further into the country."

Essex Specialties was founded in 1895 by the late Benedict Wolf. Business was great until the mid 20's when various states began passing "safe and sane" Fourth of July laws.

When Goldsmith joined the firm in 1939 the only product on its sales list was illuminating flares for the military and for trucking and rail uses. A Rutgers engineering graduate, Goldsmith also did graduate work at Stevens. He was prepared for the job ahead.

Early in the war, when the firm had become Essex Electronics, the War Production Board blocked an attempt to sell radio-activated booby-trap flares to the Army. The unsuccessful bid, however, led in a round-about way to a contract for supplying radio coils to the Signal Corps. The firm still is essentially in the coil business, though the wound wires are now used for a variety of electronic uses.

At war's end, however, the future did not look too promising. For a couple of years there was only radio. Then came the tv boom. Finally, the big spur to electronics developed with increasing demands by the military for computer systems, and then for missiles.

In 1950 Essex had opened a plant in North Hollywood to supply components for the Hughes Falcon air-to-air missile. This opened an entirely new field for the company. Bernard Goldsmith met the test.

While the firm's family lines still led back to Newark, the company was sold in 1956 to New York Transformer. Mergers two years ago resulted in the formation of Nytronics, with the descendant of the old Newark company becoming the Essex Electronics division.

Goldsmith sees a rosy future for the company. A year ago he pioneered in setting up a standardized line of coil devices, permitting immediate delivery in small quantities of what used to be custom-made items only.

Using thousands of vials and a storage wall device to accommodate them, one small supply room alone contains an inventory of 200,000 components representing 250 various types of electronic parts. (It would require 450,000 Wee-ductors, for example, to fill a cubic foot.)

On the basis of initial success in standardization, Goldsmith predicts a 10 percent growth a year over the next decade for Nytronics, which now employs 250 people.

He says he is not looking to space, particularly, but to electronic data-processing and automation to increase demands for the firm's products. At present 20 percent of its business is in rockets and satellites, a third in television and the remainder in data processing.

Perkin-Elmer Elects Lewis as President

ELECTION of Robert E. Lewis as president and chief executive officer and a director of the Perkin-Elmer Corp., Norwalk, Conn., is an-

nounced. He has resigned as president of Sylvania Electric Products Inc., a subsidiary of General Telephone & Electronics Corp., to accept the new position.

Lewis will assume his new duties on June 1st.

Hedeman Accepts GPL Appointment

GPL DIVISION—General Precision, Inc., Pleasantville, N. Y., has appointed Walter R. Hedeman coordinator of advanced development, engineering division. He will be responsible for the consolidation of advanced plans of GPL's various engineering departments and coordinating the effort with sales, planning and requirements, and research.

Hedeman was formerly assistant chief engineer for systems at Texas Instruments' Apparatus Division, and chief of electronics at Chance Vought Aircraft.

Admiral Bennett Joins Sangamo Electric

REAR ADMIRAL RAWSON BENNETT (USN Ret.), formerly Chief of Naval Research (1956-1961), has been elected a senior vice president of Sangamo Electric Co., Springfield, Ill., and appointed the company's director of engineering.

During World War II as Head of the Electronics Design Division of the Bureau of Ships, Admiral Bennett was responsible for the design of electronic equipment for the entire Navy, including shipboard and airborne equipment, ordnance radar, sonar, iff, auxiliary training devices.

He was the principal liaison officer to the Office of Scientific Research and Development. In 1939, he designed the combined sonar team trainer for asw and submarine teams.

Jerrold Elects Harman Executive V-P

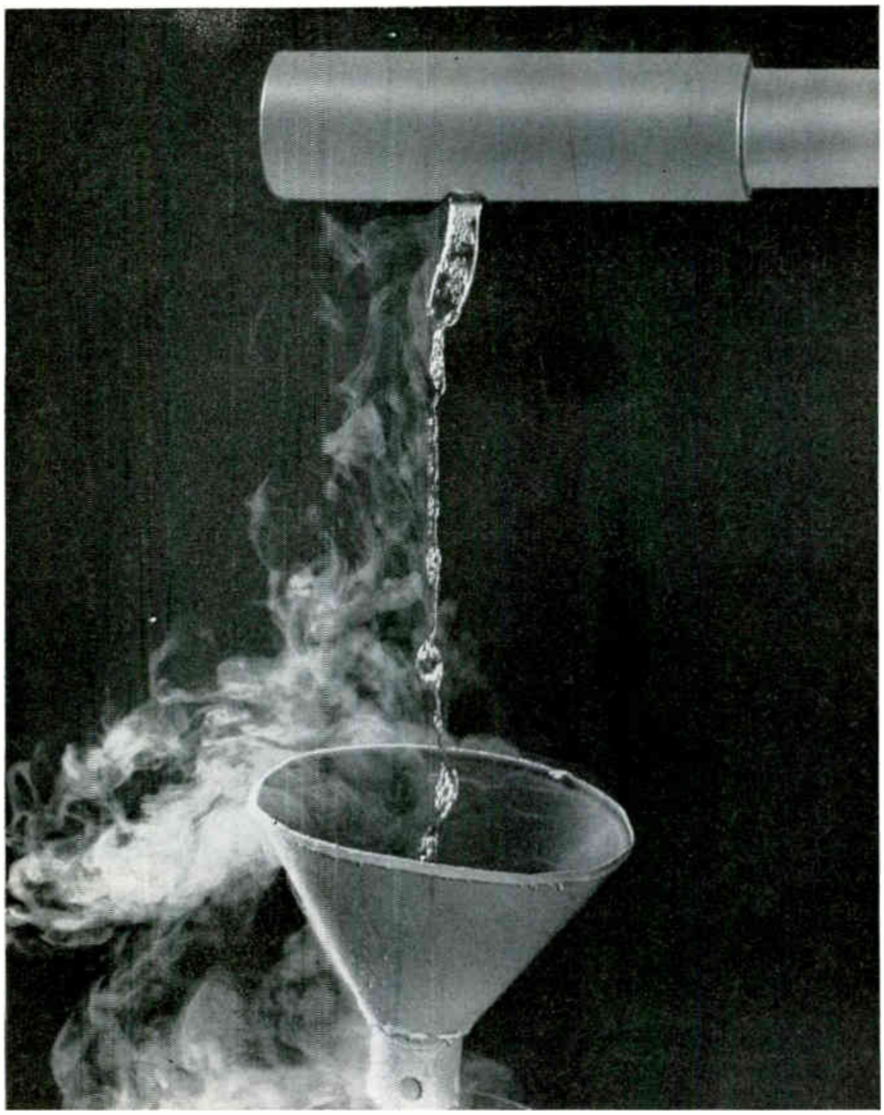
SIDNEY HARMAN, president of Harman-Kardon, Inc., Long Island, N. Y., has been appointed executive vice president of Jerrold Electronics Corp. with which Harman-Kardon merged earlier this year.

Announcement of Harman's appointment followed closely on the heels of a decision by the Jerrold board of directors to implement a program of expansion and diversification in the sophisticated areas of electronic communications and control.

Gow-Mac Instrument Appoints Lawson

THE GOW-MAC INSTRUMENT CO., Madison, N. J., has appointed Alexander E. Lawson, Jr. to the vice-presidency. Gow-Mac manufactures gas analysis instrumentation and thermal conductivity cells.

Prior to joining the company, Lawson was chief engineer of Fenwal Electronics Inc. at Framingham, Mass., and general manager



of Davis Instruments in Newark, N. J.

Fairchild Semiconductor Hires Dumesnil

MAURICE E. DUMESNIL has joined the technical staff of Fairchild Semiconductor Corporation's R&D laboratories in Palo Alto, Calif. He has been assigned to the chemistry section where he will conduct research in glass, ceramics and related fields with respect to their use in the semiconductor industry.

Dumesnil was formerly associated with the Ceramics Division, E. I. duPont deNemours, Perth Amboy, N. J.

PEOPLE IN BRIEF

Henry W. Vogtmann promoted to senior test engineer at Bendix Corp.'s Mishawaka Div. **H. J. Barker** leaves Nortronics to join Dunn Engineering Corp. as manager of the systems and test facilities dept. **George E. O'Rourke, Jr.**, advances to manager of the systems research dept. of Sylvania Electric Products' applied reseach lab. **Allan W. Greene**, president of Heath Co., a subsidiary of Daystrom Inc., elected a corporate vice president. **Daniel E. Chaifetz** of Tech-Ohm Electronics Inc. accepts the post of company president. **Arthur A. Kusnick** moves up to senior engineer in IBM's advanced systems development division. **R. T. Orth**, vice president in charge of operations at Eitel-McCullough, elected to the board of directors. **Richard M. Jansson** leaves MIT Instrumentation Labs to join Bacon Labs as project engineer. **S. D. Gurian**, previously with Radio Receptor Co., appointed executive vice president of Madigan Electronic Corp. **Milton Brenner** advances at Loral Electronics Corp. to assistant chief engineer for development. **Ernest R. Follin** transfers from Fansteel Metallurgical Corp. to the Chicago office of Gulton Industries Inc. as component specialist. **Robert A. Bernoff**, formerly with the Pennsalt Chemical Corp., chosen director of research for Materials Electronic Products Corp. (Melcor).

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1. Review the positions in the advertisements.
2. Select those for which you qualify.
3. Notice the key numbers.
4. Circle the corresponding key number below the Qualification Form.
5. Fill out the form completely. *Please print clearly.*
6. Mail to: D. Hawksby, Classified Advertising Div., ELECTRONICS, Box 12, New York 36, N. Y. (No charge, of course).

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ESQUIRE PERSONNEL Chicago, Illinois	104	3
FIDELITY PERSONNEL OF PHILADELPHIA Philadelphia, Pa.	104	4
GENERAL ELECTRIC Heavy Military Electronics Dept. Syracuse, New York	161*	5
LABORATORY FOR ELECTRONICS Boston, Mass.	87	6
McGRAW-HILL PUBLISHING CO., INC. New York, New York	104	7
MITRE CORPORATION Bedford, Mass.	163*	8
REPUBLIC AVIATION CORPORATION Farmingdale, L. I., New York	103	9
P-6669	162*	10
P-6688	162*	11

* These advertisements appeared in the 5/19/61 issue.

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Personal Background

NAME ....

HOME ADDRESS..

CITY......... .... ZONE...... STATE...........

HOME TELEPHONE..

Education

PROFESSIONAL DEGREE(S)..................................

MAJOR(S) ....

UNIVERSITY ....

DATE(S) ....

FIELDS OF EXPERIENCE (Please Check)

5261

☐ Aerospace	☐ Fire Control	☐ Radar
☐ Antennas	☐ Human Factors	☐ Radio—TV
☐ ASW	☐ Infrared	☐ Simulators
☐ Circuits	☐ Instrumentation	☐ Solid State
☐ Communications	☐ Medicine	☐ Telemetry
☐ Components	☐ Microwave	☐ Transformers
☐ Computers	☐ Navigation	☐ Other ....
☐ ECM	☐ Operations Research	☐ ....
☐ Electron Tubes	☐ Optics	☐ ....
☐ Engineering Writing	☐ Packaging	☐ ....

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Please indicate number of months experience on proper lines.

	Technical Experience (Months)	Supervisory Experience (Months)
RESEARCH (pure, fundamental, basic)	......	......
RESEARCH (Applied)	......	......
SYSTEMS (New Concepts)	......	......
DEVELOPMENT (Model)	......	......
DESIGN (Product)	......	......
MANUFACTURING (Product)	......	......
FIELD (Service)	......	......
SALES (Proposals & Products)	......	......

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...to work on computers, test equipment and instrumentation.

ELECTROMECHANICAL ENGINEERS

...with experience in servos, relays, switches and analog computers.

...to work on trainers and simulators.

If your experience is in any of these areas and you are interested in moving ahead with us, send your resume to Mr. D. J. Wishart.

AIRCRAFT ARMAMENTS, INC.
Cockeysville, Maryland
(Suburban Baltimore)

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Erie Electronics Division
ERIE RESISTOR CORPORATION
645 West 12th St., Erie, Pa. (GL 6-8592)

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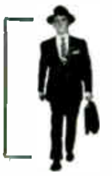
Sales reprs. wanted for quality line of R. F. Interference Free Fluorescent lighting equipment for use in areas R. F. noise can not be tolerated such as shielded rooms electronic areas. Equipment is superior to the requirements of MIL-I-16910A. Most areas open. Please describe organization and lines carried. RW-6744, Electronics, Classified Adv. Div., P.O. Box 12, New York 36, N. Y.



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Laboratory Instrumentation. Very advanced. MS or BS, 10 years experience.

Circuits & Subsystems. Problems of adaptation, miniaturization, compatibility. BS, various levels of experience.

Wind Tunnel Instrumentation. Design, Set-Up, Calibration. BS/MS and 2 or more years experience.

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where the basic concern is solving navigational, guidance & detection problems with special emphasis on physical optics, solid state & low temperature physics, thin-film techniques applied to computer elements.

Space Guidance System Development. MS Electronics, 10 years experience.

Space Computers. Hardware development. MS in Electronics and at least 10 years experience.

Space Environmental Control Systems. MS, BS with 6 to 12 years experience.

Automatic Controls. Hardware design. MS Electronics, 5 years experience.

Thin Film Devices. PhD Solid State, 5 years experience.

Optical & IR Systems, Devices. PhD Physical Optics, 5 years experience.

Optical & IR Tracking Devices. MS Solid State, 10 years experience.

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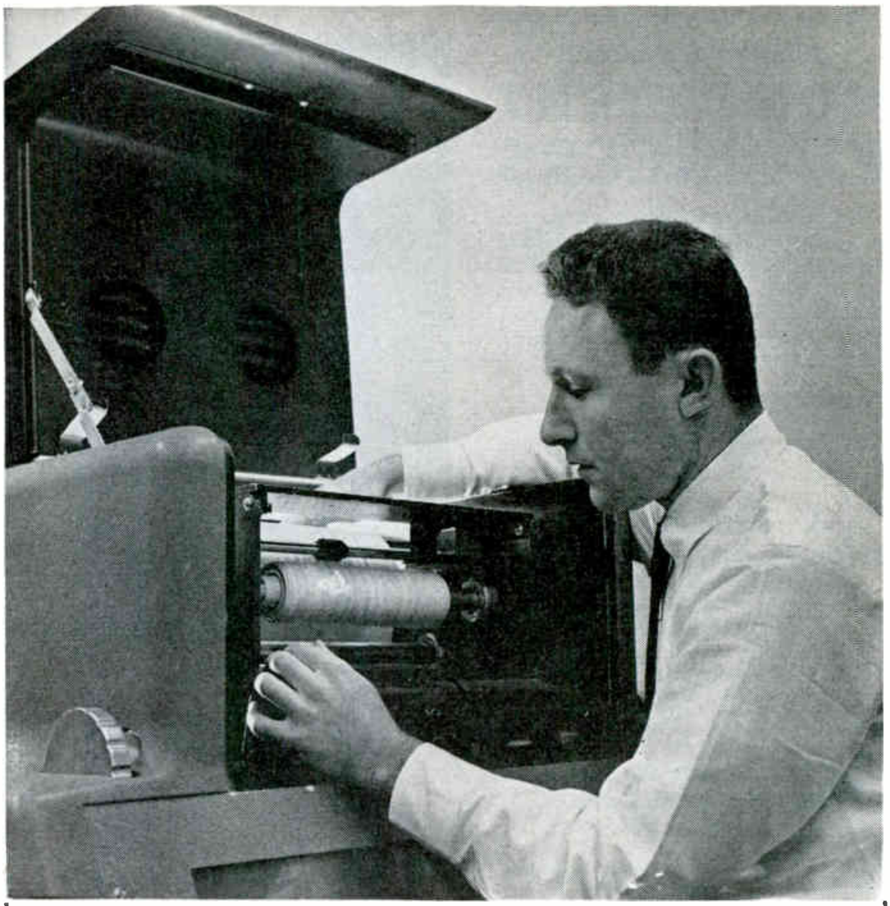

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