

MAY 2, 1958

electronics

business edition

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Astro Navigation Market Growing

Here's a comprehensive breakdown of
a \$250-million-plus business p 13



Bankers Turn To Electronics

Agreement on check preparation
methods may open new markets . . . p 15

550 Mc

60,000 Mc

More than 70 Raytheon reflex-type klystrons for local oscillator, signal generator and transmitter applications.

Raytheon produces more reflex klystrons than all other manufacturers in the world combined . . . one important reason why Raytheon klystrons have established a matchless record for reliability and

proved performance in thousands of installations. Equipment designers are welcome to call on our Application Engineer Service. Write for consolidated data booklet presenting comprehensive characteristics of the *complete* line of Raytheon klystrons, magnetrons and special tubes. There is no cost, or obligation.

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Heater Input @ 0.58 A 6.3 V
 Reflector Voltage Transit Mode 2 3/4 cycles
 Frequency Range 4290-8340 Mc
 DC Resonator Input @ 20 mA 1000 Vdc
 DC Reflector Voltage -50 to -625 V
 Electronic Tuning (Half Power) Frequency Change 12 Mc min.
 Reflector Modulation Sensitivity (8340 Mc) 0.1 Mc/volt
 Power Output (Average CW) 160 mW

RK-6116 — A ruggedized thermally tuned oscillator of the integral cavity type designed for CW operation in the 8500 to 9600 Mc range with an average power output of 30 mW.



Heater Input @ 0.52 A 6.3 V
 Tuner Heater Current 0.80 A
 Frequency Range 8500-9660 Mc
 Resonator Input @ 25 mA 300 Vdc
 Reflector Voltage (max. Po @ 8550 to 9660 Mc) -60 to -145 Vdc
 Thermal Tuning Time 8500-9660 Mc 2 seconds
 Electronic Tuning Range @ 9080 Mc 100 Mc
 Power Output 8500-9660 Mc 26 to 34 mW

QK-422 — A mechanically tuned velocity variation oscillator designed for CW operation in the 7125 to 8125 Mc range in microwave relay systems.



Heater Input @ .44 A 6.3 V
 Frequency Range 7125 to 8125 Mc
 DC Resonator Input @ 32 mA 300 Vdc
 DC Reflector Voltage (max. Po @ 7125 to 8125 Mc) -130 to -210 Vdc
 Power Output 7125 to 8125 Mc 100 mW min.
 Electronic Tuning (to half power points) @ 7600 Mc 25 Mc min.
 Modulation Sensitivity @ 7600 Mc (10 V pk. to pk. mod. volt.)5 Mc/V min.

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Microwave and Power Tube Division, Section PT-34, Waltham 54, Mass.



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Shoptalk . . .

TRACKING THE STARS. Need for precise, non-radiating navigation equipment is creating a big new market for automatic celestial tracking devices. This business has quietly mushroomed into a quarter-billion-dollar industry.

The equipment is already in demand for aircraft, air-breathing missiles, atomic submarines and surface vessels. Space navigation—where celestial bodies are the only landmarks—will provide the impetus for future growth.

Associate Editor Mason visited Air Force and Navy officials who are buying automatic astronomical navigation equipment. He also toured plants and laboratories in industry where the gear is being developed and produced.

His article, "Astro Market Growing", p 13, describes the equipment used by Navy and Air Force, estimates current demand for the equipment and points out where future business will develop.

MARKET IN BANKS. Fourteen thousand U.S. commercial banks represent a market for electronic data and paper processing equipment, estimated at \$400 million to \$500 million dollars over the next five years and \$700 million to \$800 million dollars over the next 10 years.

Until recently, sales have been slow. But, bank equipment sales are mounting fast under impetus of low-cost semiautomatic equipment introduced last year and agreements among bankers and equipment manufacturers on uniform methods for preparing bank checks for processing by electronic equipment.

Associate Editor De Jongh has been following developments in the banking field closely for more than a year. In this time he has talked with scores of equipment manufacturers, bankers associations and groups, and individual bank executives. His story begins on p 15.

Coming In Our May 9 Edition . . .

Coming In Our May 9 Edition . . .

● **Field Scope.** Specially designed cathode-ray oscilloscopes bring the ease and facility of laboratory testing techniques to field maintenance of reciprocating engines. Display on one such scope shows cyclic engine events in time sequence. According to Edward Sammis of Sperry Rand the instrument monitors ignition, vibration and pressure of spark-ignited or diesel engines and presents data on a 5-in. screen.

One indication of accuracy is that ignition mis-timing can be detected within one degree of the crankshaft position. And the scope can be connected without shutting down the engine.

● **Rapid Tube Tester.** Engineers engaged in tube reliability and testing work will be pleased with a recent development at Armour Research Foundation. Author E. S. Gordon describes a production tube tester that gives rapid indications of opens and shorts, with direct-reading localization by neon lamps. A memory circuit holds the indication of intermittent-tap shorts.

Seven tube types are presently covered, but others may be accommodated with simple wiring changes. Most frequently used tube types are tested in groups of four at a time, and minor modifications in fundamental circuit allow for idiosyncrasies of special tube types.

● **Muting Tape Echoes.** A squelch circuit that mutes magnetic tape echoes has been designed by Daniel Cronin of Bell Sound Studios. A biased-diode type of gate circuit silences the audio channel whenever signal drops to 40 db below peak.

To reduce distortion and maintain diode conduction throughout modulation, a portion of the signal is rectified and applied to the diodes through a delay circuit. Constant level of background noise is maintained by applying output of hiss generator to channel whenever quieting occurs.

● **Magnetic Modulators.** A magnetic modulator that uses saturable reactors to convert input sine-wave into narrow, high peak-power output pulses is discussed by Harry Thomas of Federal Labs. Thomas explains the basic action of current-pulse compression with magnetic modulators.

Polarizing and differentiating circuits, delay-line wave shaping, pulse permeability measurements, cancellation effects and related features leading to improved design are discussed.

● **Powering Transistors.** Low voltage and current requirements of transistors make it possible to supply power to them through electromagnetic radiation. An energy storage system described by L. R. Crump of Diamond Ordnance Fuze Labs supplies all power needs for specially designed transistor circuits.

Operation consists of receiving and rectifying r-f radiations, storing resultant d-c energy and releasing the energy as required to associated circuits.

Issue at a Glance

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- Comment**p 10
- Astro Now Major Market.** The sky's the limit for automatic astronomical navigation gear, both operationally and business-wise. Already used in aircraft, missiles, ships and subs, automatic astro is a natural for space flightp 13
- Bankers Buy More Electronics.** Equipment sales to commercial banks are expected to mushroom. Cumulative sales should reach \$800 million in a decade; 14,000 U. S. banks provide market.....p 15
- Production and Sales.** Binurals Boost Hearing-Aid Sales.....p 16
- Bell System Keeps Buying.** The Bell Telephone System remains a substantial and growing market for electronic components and equipment. Both telephone service expansion and military subcontracting contribute. .p 18
- Soviet Rocket Gear.** They say a single-stage rocket carried 1½ tons of instruments, went up 294 mi.....p 19

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DIGEST continued

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Russians Find Orbit With Doppler Technical Digest Electronics Steers Test Tractor Meetings Ahead

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Research in a Vacuum Coaxial T-R Tube in Production
Etchant Keeps Renewing Self Laminating Film Needs No Glue

Navy Eyes Electron Motors. Sea branch is on the verge of a breakthrough in turning heat to electric power by thermoelectric couples. p 26

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Progress in British Missiles. Two missiles are operational, two near operational. Several long-range ones are under development. p 34

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electronics

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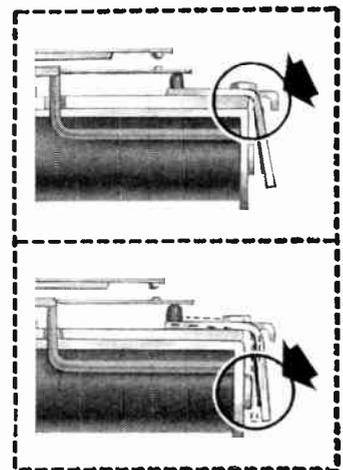
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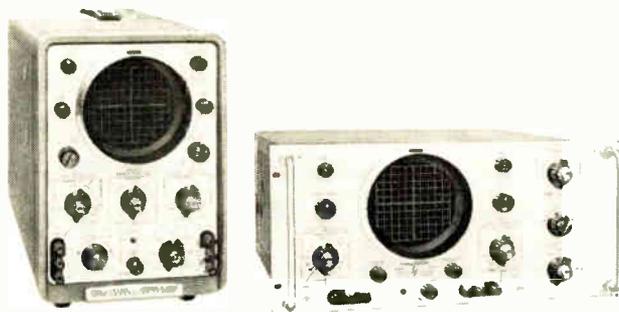
dc to 10 MC—\$1,100

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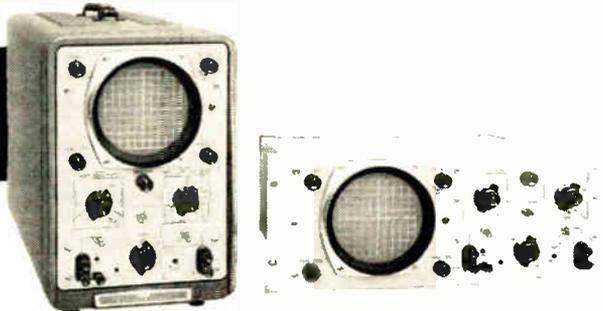
dc to 300 KC—\$650

Models 130A/BR, similar horiz. and vert. amplifiers, input circuits balanced 5 most sens. ranges. Single ended input ac or dc coupled. 1 μ sec/cm to 12.5 sec/cm; 21 sweep times. 130BR includes x 5 magnifier. 130A (cabinet) or 130BR (rack) \$650.00.



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-hp- accessories extend oscilloscope performance



-hp- 152B Dual Trace Amplifier (for 150A/AR) provides differential input and dual traces electronically switched between A and B channels at either 100 KC or on alternate sweeps. \$250.00.



-hp- 153A High Gain Amplifier (for 150A/AR) permits 150A to be used for direct-from-transducer measurements without preamplification in many cases. Maximum sensitivity 1 mv/cm. \$125.00.



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-hp- AC-21C 50:1 Voltage Divider Probe for 150A but usable with most other 'scopes, VTVM's, preamplifiers. 10 megohms input impedance; 2.5 μ f input capacitance. \$25.00.



-hp- 115A Oscilloscope Cart. Designed for 150A, fits other 'scopes. Heavy chromed tube steel construction, lightweight. Scope shelf tilts 30° in 7½° increments. 4" rubber tired wheels, brakes. \$80.00.

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Plant Spending Firms

Worst of the capital goods decline may be over. Electronics held up best.

LATEST NEWS about capital goods spending is that business plans to stabilize such expenditures sometime in 1959 and maintain the new level in 1960-1961.

This conclusion is made by the McGraw-Hill Department of Economics in its report on Business Plans for New Plants and Equipment 1958-1961, released in the last fortnight.

This news has much meaning for the fast-growing industrial electronics segment of our industry. Sales are largely dependent on capital spending.

Here are the summary figures on planned expenditures:

For all business, present plans indicate capital spending of \$34 billion in 1958, \$31 billion in 1959 and 1960 and \$30 billion in 1961. Planned spending for 1958 is down 12 percent from the \$38 billion spent last year.

However, not all industries are cutting back in 1958. The electrical machinery group, including some of the electronics industry, is increasing plant expenditures four percent. Three of our important customer groups also plan increased spending. Both utilities and general machinery industries plan three percent increases while railroad equipment spending should be up 36 percent.

Capital expenditures now planned for 1958-1961 by all business are below maximum companies would spend under favorable conditions and above minimums they would spend if sales decline substantially.

Depending on economic conditions and the federal tax policy, average capital spending for all busi-

ness in the 1959-1961 period could be as high as \$39 billion and as low as \$22 billion.

Even though chances are that capital spending will be less than boom-year 1957 for several years to come, industrial electronic sales should continue upward.

Usually conservative Standard & Poor's recently predicted industrial and commercial electronic revenues should climb about 10 percent in 1958. Last year industrial electronic sales increased 37 percent over the \$950 billion level in 1956.

Reason: industry is putting an unprecedented share of its capital investment into modernization.

For instance, in 1958 some 56 percent of capital spending is going for modernization and only 44 percent for new capacity. The 1959-1961 plans call for 62 percent investment in modernization and only 38 percent for expansion.

Behind the shift in spending from new capacity to modernization is a decline in operating rates.

Average manufacturer was operating at 78 percent of capacity at end of 1957 compared with 86 percent in 1956 and 92 percent in 1955.

Result: industry will be spending more and more money on electronic and other means of automation in order to preserve profitable operations, though producing at a lower level of capacity.

As for the years beyond 1961:

Higher future levels of capital spending are being built by record expenditures on research and development for new products and industrial processes.

Industry spending for research and development reached a record \$7.3 billion in 1957. Industry plans to spend \$8.3 billion this year and \$10 billion by 1961.

Mounting research and development spending today means electronic firms and other capital goods sellers will reap big benefits several years from now. That's when new factories will be built to manufacture new products born out of R&D.

SHARES and PRICES

SOME RUBBER MANUFACTURERS are playing increasingly important roles in manufacturing electronic equip-

ment. General Tire, through its 86 percent owned subsidiary, Aerojet-General, is active in infrared detection, tracking and guidance, and missile test facilities. Firestone

is the prime contractor for the Corporal missile. Goodyear is furnishing the electronic guidance and ground support equipment for the Mace, a successor to the Matador.

Typical Manufacturers of Both Rubber and Electronic Products	Recent Price	Indicated Dividend Rate	Percent Yield	Earned Per Common Share			Traded	1958 Price Range
				1957	Period	1956		
Firestone.....	83½	2.60 ¹	3.1	7.49	(year) ²	7.44	NYSE	83½-93½
General Tire.....	23½	0.70 ¹	3.0	0.35	(year) ³	0.32	NYSE	22¼-30
Goodyear.....	72¼	2.40 ¹	3.3	6.12	(year)	5.90	NYSE	69-84½

¹ plus stock

² fiscal ended Oct. 31

³ fiscal ended Nov. 30

MERGERS, ACQUISITIONS and FINANCE

• **Early first quarter earnings** reports for period ending March 31 are mixed. Raytheon's earnings of \$1,734,000 were 52 percent ahead of last year. G.E.'s net profit dipped 23 percent to \$49,184,000. Texas Instruments established a quarterly record with earnings of \$1,109,000, 40 percent above last year. IBM, with a net income of \$23,396,118, beat the 1957 first quarter by 25 percent. Westinghouse reported that first quarter earnings this year would be 23 percent less than last year. Thiokol Chemical's earnings of \$203,109 were off 32 percent.

• **Federal Trade Commission**, late last month, reported corporate mergers in all industries generally are decreasing under the influence of the recession. FTC noted 226 mergers were under negotiation in the first quarter of 1958 compared with 238 a year ago. General trend is in sharp contrast to the electronics industry where merger pace accelerated in first quarter.

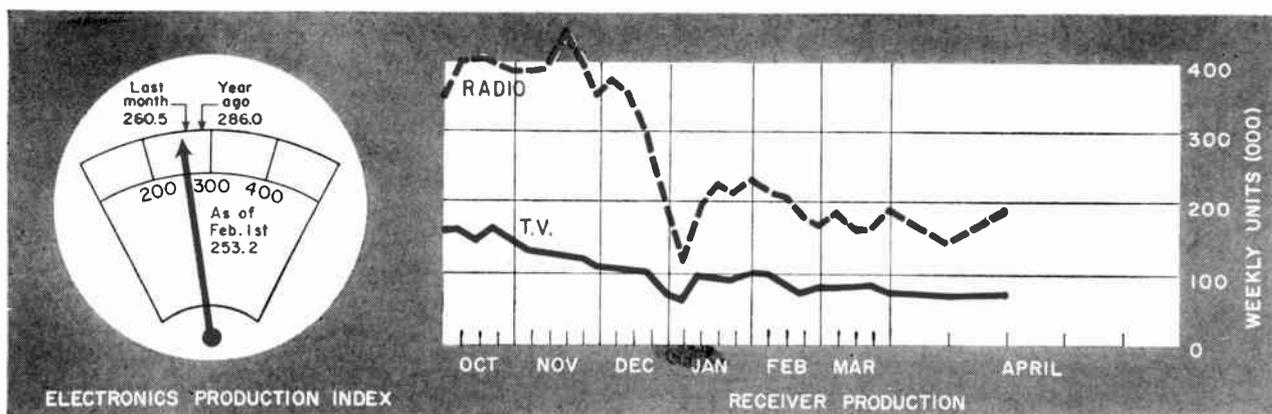
Comments one of the industry's merger specialists: "Electronics industry mergers will continue at a lively rate because of military preference for placing prime contracts with large companies; increasing sophistication of the industry requiring more extensive facilities and more complete organizations; and the difficulty of small companies to grow into large ones through retention of earnings."

• **National Aeronautical Corp.**, Fort Washington, Pa., increases regular quarterly cash dividend on common stock from five to six cents per share. Previous dividend payment was 25 cents per share, but firm's stock was split five-for-one on March 31. Decision was based on firm's favorable sales picture during first four months of its fiscal year which ends Nov. 30.

• **Universal Transistor Products**, Westbury, Long Island, N. Y., obtains a \$270,000 V-Loan through decision by comptroller general of

the U. S. interpreting civil defense as part of the national defense program. To the Westbury firm's knowledge, this is the first time a V-Loan has been obtained for a civil defense contract. The contract was for equipment used in determining extent of radiation exposure. The decision opens opportunities for many small firms to participate in the civil defense program, says U.T. president James A. Gannon, Jr.

• **Beckman Instruments**, Fullerton, Calif., announces major changes in organization are contemplated as a result of a survey conducted by management consultants. Beckman has operated with six virtually autonomous domestic divisions in eight plants in three states. Contemplated changes would provide a greater measure of corporate control to obtain closer coordination of firm's varied activities. Substantial economies are expected from elimination of overlapping or duplicating of functions.



FIGURES OF THE WEEK

RECEIVER PRODUCTION

(Source: EIA)	Apr. 11, '58	Apr. 4, '58	Apr. 12, '57
Television sets, total	76,954	70,309	94,866
Radio sets, total	183,461	148,040	287,682
Auto sets	61,024	41,698	93,885

STOCK PRICE AVERAGES

(Source: Standard & Poor's)	Apr. 16, '58	Apr. 9, '58	Apr. 17, '57
Radio-tv & electronics	44.76	44.89	50.99
Radio broadcasters	58.31	57.09	68.21

FIGURES OF THE YEAR

	1958	Totals for first two months	
		1957	Percent Change
Receiving tube sales	56,466,000	82,031,000	-31.2
Transistor production	6,061,955	3,221,000	+88.2
Cathode-ray tube sales	1,178,046	1,489,223	-2.1
Television set production	804,396	914,887	-12.1
Radio set production	1,903,418	2,350,294	-19.0

LATEST MONTHLY FIGURES

EMPLOYMENT AND EARNINGS

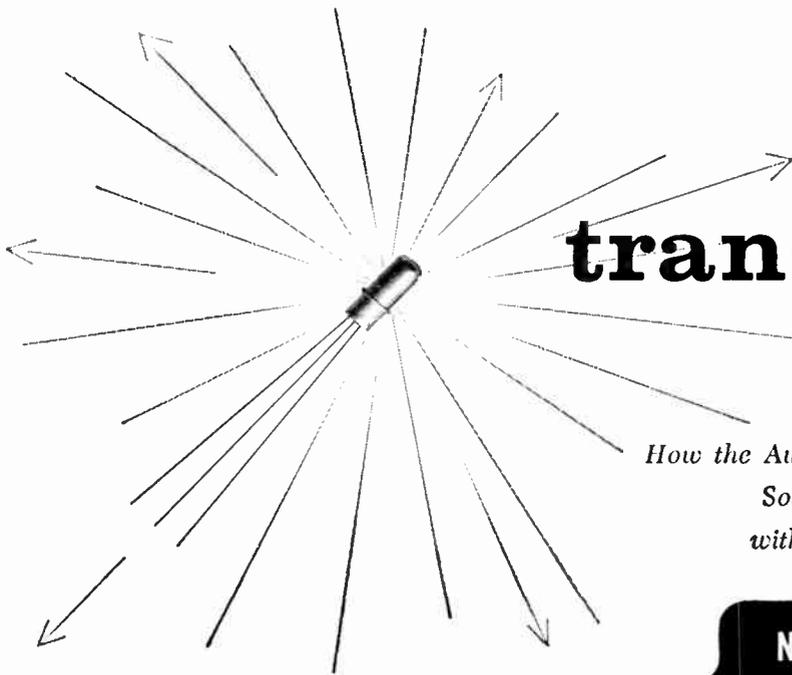
(Source: Bur. Labor Statistics)	Feb. '58	Jan. '58	Feb. '57
Prod. workers, comm. equip.	349,800	362,000	394,600
Av. wkly. earnings, comm.	\$79.75	\$79.15	\$80.18
Av. wkly. earnings, radio	\$78.98	\$77.40	\$76.80
Av. wkly. hours, comm.	38.9	38.8	40.7
Av. wkly. hours, radio	39.1	38.7	40.0

TRANSISTOR SALES

(Source: EIA)	Feb. '58	Jan. '58	Feb. '57
Unit sales	3,106,708	2,955,247	1,785,000
Value	\$6,806,562	\$6,704,383	\$5,172,000

TUBE SALES

(Source: EIA)	Feb. '58	Jan. '58	Feb. '57
Receiving tubes, units	29,661,000	26,805,000	44,460,000
Receiving tubes, value	\$25,650,000	\$23,264,000	\$36,631,000
Picture tubes, units	556,136	621,910	728,363
Picture tubes, value	\$11,210,527	\$12,341,927	\$13,134,778



transistor failure?

How the Autonetics Division of North American Aviation Solved This Costly Reliability Problem with RADIFLO Non-Destructive Testing

NORTH AMERICAN AVIATION

Hundreds of transistors were tested for leakage with the RADIFLO Leak Detection System by Autonetics. Environmental tests of these transistors conclusively showed: (1) a high percentage of transistor failures-in-circuit are due to leakage, and (2) such failures are virtually eliminated when transistors pass a RADIFLO test of 10^{-11} cc/sec.

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The RADIFLO Leak Detection non-destructively measures leakage to 10^{-12} cc/sec.—after units are completely sealed. It permits Go-No-Go parts-grading by leak rate...without electrical or mechanical harm to the component. Sensitivity is 1,000 times greater than any other method. The system can be completely automated.



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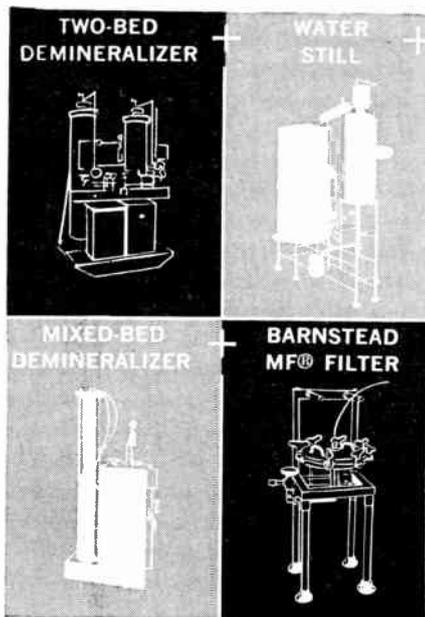


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NEW: TRANSISTOR WASHER

This apparatus washes and rinses transistors and other small electrical parts in hot distilled, demineralized water. New repurification process conserves thousands of gallons of demineralized water each day.



WRITE FOR BULLETIN #146

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CHICAGO Mulberry 5-8180	PHILADELPHIA LOCust 8-1796	LOS ANGELES RYan 1-9373
JOHNSON CITY 3113	SAN FRANCISCO TEmplebar 2-5391	CHATTANOOGA 6-5863

84 Lanessville Terrace, Boston 31, Mass.

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WASHINGTON OUTLOOK

The Navy's budget headaches have been outlined to the House Appropriations Committee along with plans to cut back procurement and delay production. Aircraft procurement, originally set for 1,200 in fiscal 1958, has been scaled down to 898. In addition, delivery of 408 planes will be postponed. In all, aircraft deliveries for this year will total 1,715 rather than the 2,123 initially scheduled. In fiscal 1959, new orders for aircraft will slip to 707.

Procurement will get under way of an improved antisubmarine warfare patrol plane to supplement and gradually replace Sikorsky's turbine-powered ASW helicopter and the Grumman S2F-3. Grumman's twin-engine, carrier-based W2F-1 early-warning radar plane will have greatly improved detection capability and will be equipped to control fighter interception of aircraft.

- In missile development and production, the Navy plans to boost Bendix's Talos project to \$13.7 million in fiscal 1959, up \$3.7 million from present schedules. One objective: a missile with increased range and altitude, to be evaluated in about 18 months.

Other planned missile increase: Convair's Terrier surface-to-air missile to be stepped up by \$6 million to \$17 million; the Philco-General Electric Sidewinder project to be increased by \$1.3 million to \$8.5 million; Temco's Corvus air-to-surface missile will be boosted \$8.5 million to \$43.3 million.

- Heated dispute over the Eisenhower administration's proposal to overhaul Defense Dept. organization has gone into high gear, as Congress starts its detailed study of the plan. While the President appears to be going all out in pushing his Pentagon reorganization scheme through, the administration has substantially modified the most controversial provision—the one dealing with the Secretary of Defense's control over military appropriations.

The administration now says it seeks only flexibility for the Defense Secy. in earmarking defense funds. The flexibility will be sought in either of two forms: granting the Secretary power to transfer 5 to 10 percent of congressional appropriations from one service or project to another; changing the budget structure to reduce the number of military budget funds, thus allowing easier allocation of funds among different projects.

- Washington is agog over a cryptic disclosure to the House Outer Space Committee by Rear Adm. John T. Hayward, Assistant Chief of Naval Operations for Research and Development, that two major electronic breakthroughs have given the U. S. amazing new detection capabilities.

First, the moon itself would be used as an earth reconnaissance satellite—prior to the successful launching of artificial surveillance-equipped satellites or rocket landing on the moon. Second, the entire globe would be monitored through electronic processes of ion emission for missiles, aircraft, satellites and atomic explosions.

Hayward refused to say anything else in open session and other top level military scientists have clammed up on the subject.

But one source explains that the ion emission break-through stems from United States tracking and study of the two Soviet sputniks.



Defense blindspot removed by

DARE

New missile guidance system tracks targets unseen by other airborne systems.



SANDERS' "DARE" TEAM was headed by William Morgan, Coherent Ground System; Kenneth Dollinger, System Project Engineer; Alfred Cann, Missile Seeker; Robert Stetson, High Voltage and Microwave Circuits.



500,000 SQUARE FEET OF FLOOR SPACE give Sanders Associates ample room for expanded research, development and production of electronic, electro-mechanical and hydraulic components, sub-assemblies and systems . . . in interchangeable modular designs or sub-miniature packages.

Developed under Army Ordnance sponsorship, this unique radar, "DARE," is Sanders' solution to the military problem of detecting and tracking low-flying targets obscured by the background of the Earth.

DARE exploits Sanders' capabilities in both systems and components. The same personnel who speeded this system through study and demonstration stages have contributed successive significant "break-throughs" in missile and radar developments since 1945.

Design and production of key missile components has enhanced and assured success of the DARE project. Sanders Associates is a well-known creator and producer of *hydraulic servos* for steering and controlling missiles and antennas . . . *rate gyros* for stabilization and control . . . *microwave components* for antenna and RF circuitry . . . *flexible printed circuitry* for decreasing size and weight and increasing system reliability.

Systems capability at Sanders extends in many directions. Research, development and production experience and facilities are geared to accelerated progress in anti-submarine warfare, fire control, electronic countermeasures, autopilot and industrial automation systems. Sanders Associates can find answers to your systems problems, too.



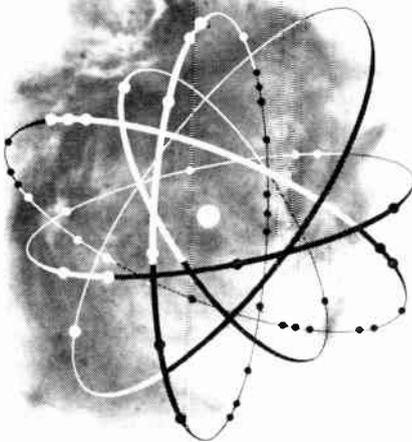
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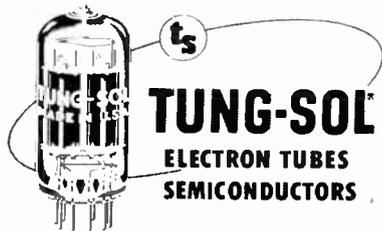
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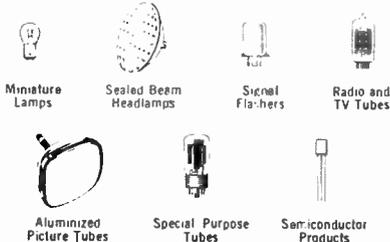


Symbol for silver . . . the element used in grid support wires to conduct heat away from grid.

Just as engineers recognize Ag as the symbol for silver, so do they associate the name Tung-Sol with the highest quality production of electron tubes to volume requirements. This ability is a major reason why Tung-Sol is America's largest independent electron tube manufacturer.



Tung-Sol Electric Inc., Newark 4, N. J. Manufacturers of Automotive and Electronic Components.



CIRCLE 6 READERS SERVICE CARD

EXECUTIVES IN THE NEWS



Malcarney: direct approach

BIG MAN behind the ballistic missile early-warning system now being built for the Air Force (ELECTRONICS Apr. 4, p 15) is Arthur L. Malcarney. Keeping the BMEWS ball of wax in the air is part of the stocky, forthright Malcarney's job as executive vice president for defense electronics of Radio Corporation of America.

Lifetime RCA-man Malcarney had held the top corporate post in defense electronics for only eight months when the \$700-million-plus BMEWS contract came along. For the year before that he'd been vice president on the commercial products side. One of RCA's younger top-flight officers, his specialty is people: he understands them, says that one of management's biggest jobs is using manpower efficiently.

Malcarney was born in Ramsaytown, Pa., in 1913. He went into the Army Air Corps at 17, went to work as an inspector for RCA in Camden, N. J., when he came out three years later. While climbing the ladder in parts manufacturing, he took courses at the University of Pennsylvania. When he reached the management mags, he went through Harvard's advanced management course.

The defense products post already had him riding a carousel between Canaveral and his Camden headquarters; BMEWS makes it turn even more hectically. His wife Anita (they were married in 1936) has given up trying to predict where he'll be or when. "He's a bigamist," comments an aide, "married to his wife—and his job."

Malcarney counters "I get a lot more relaxation than people think I do." His direct approach to things makes it easy for him to drop work when the day is done. He still takes a couple of hunting trips a year—with one of his three sons if schedules coincide. He likes football and baseball: "up until a few years after the war I still managed to play a little. Now I'm a rooter."

COMMENT

Radar and Space

Got quite a kick out of reading your "Radar Meets Space Challenge" (Apr. 4, p 15)—especially

after all the things that have been said about the obsolescence of radar. But a couple of points confused me.

You say "BMEWS will be installed within two years. Design

work is finished . . . ” Yet I understood that the design was just being undertaken and that the network wouldn't be in until 1963.

Also, as far as multifrequency transmissions are concerned: will BMEWS radars operate this way? I'd heard about this development by another name and from another source.

Thirdly, I thought the FPS-16, the radar RCA uses on the range at Canaveral, was going to be souped up for use in the early-warning system. Is it or the FPS-17 going to get the job?

GENE C. GOODMAN
PHILADELPHIA, PA.

To take reader Goodman's points in order: Although the precise installation target date is being kept under the Air Force's brass hat, we were able to discover that the basic design of the big radar is finished and that the target date is less than two years away. Multifrequency transmission may be a feature of the long-range set; the way it was put to us was that it's there to use and they like it; frankly, we feel it'll be there if they can work it in. Thirdly, souped-up FPS-16's will be part of BMEWS; like DEW-line, the new net will use several types of radar to meet varying requirements.

Satellite Panel

In "Who'll Head Space R&D?" (Mar. 7, p 15) you refer to the "National Academy of Science's rocket and satellite panel". Because you may wish to refer to this active group again, I want to point out that although many of the panel's members work closely with the National Academy of Sciences, the panel itself is not an affiliate organization.

The National Academy of Sciences is responsible for the U.S. National Committee for the International Geophysical Year, which includes a Technical Panel for the Earth Satellite Program, but the rocket and satellite research panel is a separate and independent group.

HOWARD J. LEWIS
NATIONAL ACADEMY OF SCIENCES
WASHINGTON, D. C.

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TRACKING ANTENNA

OWERING 90 feet above the New England countryside at Westford, Mass., this giant 84' tracking antenna is part of a new, long-range radar installation now studying problems in ballistics missile defense.

Equipped with an elevation-azimuth type mount designed and fabricated in cooperation with M. I. T.'s Lincoln Laboratory, the big dish can make a full 360° horizontal sweep and has a vertical rotating capability of 90°. Like all Kennedy steerable antennas, it features a light weight, aluminum dish supported by a steel pedestal mounted on a concrete base.

This kind of achievement in antenna design and construction is solid proof that Kennedy is the name to remember when you are faced with antenna problems.

ANTENNA EQUIPMENT

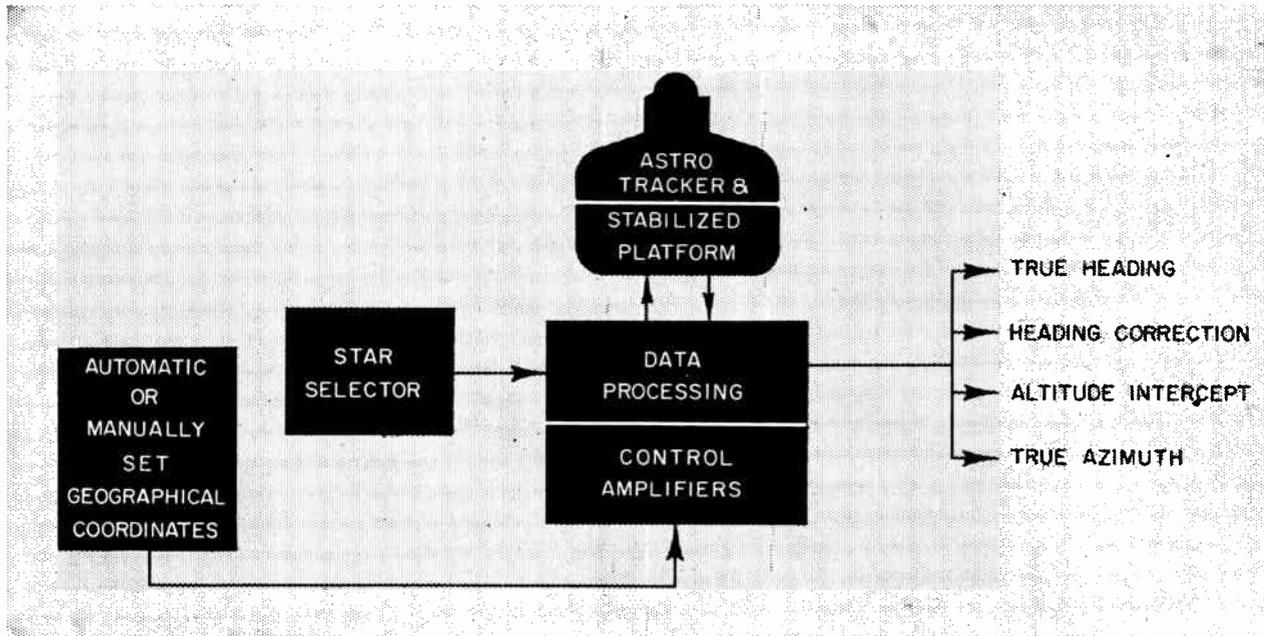
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Automatic astro compass system for B-52's and B-58's

Astro Now Major Market

Three factors push astro navigation gear into the big league: (1) It's silent, nonradiating, nonjammable; (2) It's an excellent complement to inertial guidance; (3) It's a natural for space flying

THE FACT THAT ASTRO NAVIGATION GEAR is finding a place in almost anything that moves over an extended period of time has created a new and rapidly growing business for electronics firms.

Only two years ago, the business had virtually no production contracts. Today a survey of 12 producers shows its production and R&D hit \$250 million plus. Moreover, industry sources think this figure will double in three years.

Two general categories of astro navigation devices, based on the sector of the electromagnetic spectrum in which each operates, are currently in use: optical (visual light and infrared) and radiometric, which is in the radio astronomy range.

Automatic optical sextant systems using electronic computers measure by visual light or infrared the altitude and azimuth of celestial bodies. Radio-

metric sextants line up their sights on electromagnetic radiation coming from celestial bodies.

Optical sextants are divided into three types based on the transducer used for sensing: visual ("eyeball"), photoelectric (multiplier phototube and image orthicon) and infrared.

Visual and photoelectric operate from the ground up at night and—due to the diminished brightness of the sky at high altitude—can track stars above 70,000 ft during the day.

This daytime low altitude gap is filled by infrared. Since sky brightness does not blind infrared detectors, infrared trackers can pick up second magnitude stars at sea level in broad daylight. Infrared trackers are light in weight. Potential application includes aircraft, missiles, ships and subs. Northrop, Farrand and Santa Barbara Research Center div. of Hughes

are working on infrared star tracking equipment.

No infrared trackers are on order for the Polaris subs. BuShips, however, does have one such contract active.

Within the optical category, Polaris atomic subs will use only visual equipment. A programmed electronic computer and servomechanism will automatically train the high-powered telescope on the star. The operator will then center it manually.

Photoelectric equipment may eventually get into the Polaris sub program, depending on the outcome of a new photoelectric approach now under study.

Conventional photoelectric sextants are already scheduled to go on other submarines.

Kollsman is currently supplying two submarine photoelectric sextants to prime contractor Kollmorgen for BuShips. They will be evaluated on a submarine this month.

Although similar to Kollsman's airborne gear, the sub version is more rugged and more accurate. Encased in a cast aluminum case, it weighs about 125 lb (aircraft models weigh about 45 lb).

Reeves has a photoelectric sextant now on the *U. S. S. Compass Island*. The optical and photoelectric cell portions were supplied by Eastman Kodak. Reeves developed the stable platform (accurate within seconds of arc) and two computers.

On the same ship, Farrand has a photoelectric sextant using an image orthicon tube as a sensing device instead of a multiplier phototube.

Two Kollsman airborne photoelectric devices using multiplier phototube sensing elements are currently being tested: the astro tracker (see cover photo) and the automatic astro compass (see diagram p 13).

The astro tracker determines the elevation and relative bearing of navigational stars. The navigator takes this information and computes his position.

The astro compass—actually a star tracker and a spherical computer combined—solves the celestial triangle, takes the tracker's observations, compares the results with the assumed position the navigator has stored in the computer, and comes out with aircraft true heading and the difference in position.

The automatic astro compass will go into the B-52 and similar equipment is slated for the B-58.

Future business for the simpler astro tracker looks promising since bomb-nav systems into which the tracker will go already include computers. Trackers also may have application in long range fighters and transports.

In January, 1956, Kollsman had no government production contracts. By Dec. 1956 it had a \$26 million backlog for astro compasses alone. By the end of 1957 it had a \$30 million backlog. All pro-

duction work, so far, has been for aircraft equipment.

Guided missiles using photoelectric trackers are Northrop's intercontinental range Snark and probably Fairchild's intercontinental diversionary Bull Goose (guidance by Ramo-Wooldridge).

Including the ground support equipment, Snark's stellar-inertial system, produced by Nortronics div. of Northrop, will bring in a \$60 million business during 1958. Now in quantity production, the system is a completely automatic, stellar-inertial system.

North American's Autonetics div. developed—and in 1952 test flew—a star tracker for the now extinct Navaho guided missile. Evolving from this system is the N2J star tracker to be used in IBM's AN/ASQ-28 bomb-nav system for the North American B-70.

DuMont is now working under contract with one of the services on a photoelectric star tracker for space flight. Northrop also has equipment with interplanetary potential. Another possibility is Kollsman's automatic celo-navigator which began as a study contract in 1946. Kollsman expects to have a new contract for space this year.

The radiometric sextant's strong point is under-the-weather navigation. Before it is widely used, however, a number of obstacles must be overcome.

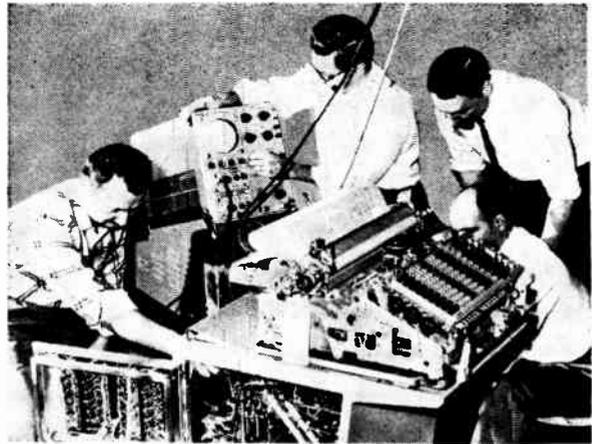
A system combination ordered for the Polaris subs consists of both photoelectric and radiometric. Kollmorgen Optical will supply the periscopes. Detroit Controls is responsible for the radiometric sextant and for line of sight stabilization for both photoelectric and radiometric sextants. Used in the line of sight stabilization system is a digital computer built by Epsco. Radiometric portion of Detroit Controls' sextant is being supplied by Euen Knight.

Euen Knight is currently testing a shore-based, 28-ft dish radiometric sextant. The company is also carrying on exploratory efforts using broad-band maser to cut down the dish size. According to the Navy, radio stars will one day be usable by submarines.

Detroit Controls' radiometric sextant, originally designed for the *Compass Island*, was to track radio stars and the moon. When the ship-launched Jupiter program was dropped in favor of a submarine-launched Polaris, the sextant was never finished. Now the submarine version will track the sun and moon but no radio stars.

Collins' AN/SRN-4 radiometric sextant which tracks the sun and moon will go on the *Compass Island* this summer. After evaluation aboard ship, the Navy may want the equipment converted for Polaris subs.

Equipment sales to commercial banks are expected to mushroom. Cumulative sales should reach \$400 million to \$500 million in five years; \$700 million to \$800 million in a decade. Manufacturers will offer equipment to meet needs of 14,000 U. S. banks



Inside view of electronic posting machine

Bankers Buy More Electronics

SALES OF ELECTRONIC EQUIPMENT for automation of commercial bank operations, already going great guns, are expected to mushroom in two to three years, say manufacturers of electronic equipment and banking industry leaders interviewed recently by ELECTRONICS.

Some degree of electronic automation of check handling will become a practical reality and a must for almost all of the nation's 14,000 commercial banks. A wide range of equipment has been developed by manufacturers.

Equipment prices range from \$10,500 for semi-automatic electronic posting machines, that add or subtract checks to depositors' accounts, to giant million-dollar-plus general-purpose digital computers. New semiautomatic posting machines—like NCR's (cover) and Burroughs' (above)—are already in use.

Some manufacturers have announced availability dates for all kinds of optional electronic auxiliary equipment—magnetic character check sorters (1958); magnetic imprinters or encoders (1958); proof and distribution machines (1960) and converters for punched paper tape output of sorters and tape input for posting machines (1960). Tape input will fully automate semiautomatic electronic posting units.

Approximate cumulative 10-year-market breakdown is: electronic bookkeeping machines, \$300 million to \$400 million; computers (large, medium and small), \$200 million to \$300 million; check sorting and other peripheral equipment, about \$200 million. Some manufacturers say 10-year cumulative sales may hit a billion dollars.

Behind the trend toward electronic automation of bank operations is a rising flood of check handling

work. Number of checks drawn has been increasing at rate of 10 percent annually. Total checks drawn was eight billion in 1953, some 11 billion last year and is expected to hit 14 billion by 1960 and 22 billion by 1970.

Automation of bank operations offers only possible alternative to problems of more paper handling and bookkeeping and trend of wage inflation and fewer workers, bank executives say.

More than a dozen electronics and business-equipment manufacturers are setting their caps for the commercial banker's equipment dollar.

Two firms have announced a complete line of electronic equipment for banks ranging from inexpensive semiautomatic posting machines to giant computers and a complete assortment of peripheral equipment.

Two large office-equipment firms do not expect to compete for posting machine business, but will offer all sizes and types of general-purpose computers plus check sorters and other peripheral equipment. One electronics manufacturer is making special-purpose computers for banks, has a production contract for 36 of the units, according to reports. This firm will also make check sorters.

One other large electronics firm is getting ready to announce that it has developed a computer for commercial bank use.

Bankers have been getting ready to buy electronic automation equipment for some time. The Technical Committee on Mechanization of Check Handling of the American Banker's Association has been working on establishment of uniform methods of

preparing checks for electronic processing for several years.

The Technical Committee expects to complete its work before the year is out, possibly by summer says its chairman, John A. Kley, executive vice-president of The County Trust Company, White Plains, New York. However, many of the ground rules have already been worked out. Most machines under development conform to these rules.

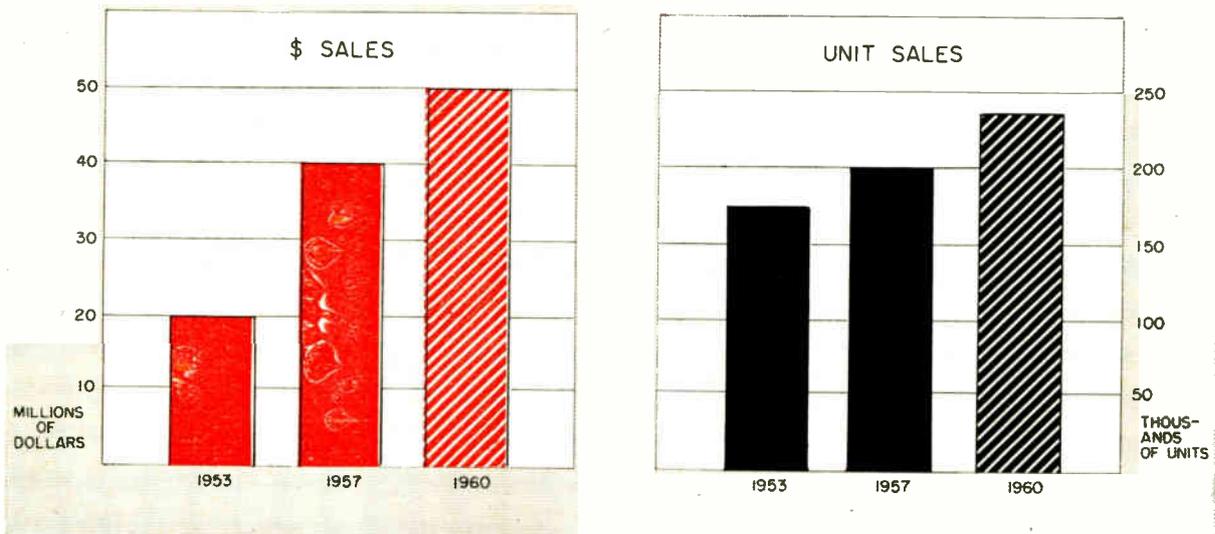
When ABA standards are announced, banks will be able to initiate use of magnetic preprinted checks within several months. Printers will preprint depositor account number and bank number on checks in magnetic ink while banks will imprint amount of check after it is returned to them for processing. Checks then can be automatically sorted, posted and listed by name of account, name of bank and amount of check through electronic sensing of magnetic data.

But sales are not all in the future. Sales have been at a rapid rate for more than a year as a result of the ABA committee's decision in July 1956 to use a magnetic character recognition system. Bankers felt safe in ordering semiautomatic electronic posting equipment knowing it could be integrated and used with other equipment to come.

By the end of this year, one manufacturing firm estimates it will have delivered nearly 2,000 semi-automatic electronic posting machines.

ABA committee decisions, indicating full-scale bank automation would come soon, have also led to increased sales of computers for mortgage, installment loans, Christmas Club accounting and payroll analysis. Bankers felt that by starting on electronics for miscellaneous use they would be able to prepare themselves for more complete automation later on.

PRODUCTION and SALES



Binaurals Boost Hearing-Aid Sales

HEARING-AID SALES have been mounting rapidly under the stimulus of binaural type aids. Introduced about 1953, they accounted for about 25 percent of total dollar sales last year.

Binaural aids, manufactured in the form of eye glasses for men and barettes for women, have separate microphones, amplifiers and ear-phones for each ear and use almost twice as many electronic parts as the monaural types.

Average retail cost of binaurals is about \$400 compared with aver-

age retail cost of around \$250 for the monaural type. Hence dollar sales have been mounting more rapidly than unit sales.

Leland A. Watson, president of Maico Company, recently predicted hearing aid sales, which amounted to \$20 million in 1953 and \$40 million in 1957, would hit \$50 million by 1960, an estimated gain of 150 percent for the eight-year period.

At the same time, he predicted unit sales of hearing aids, 175,000 in 1953 and 200,000 in 1957,

would total about 240,000 by 1960.

Manufacturers expect growing popularity of binaurals will produce increased sales for years to come. They believe many hearing loss sufferers, now without aids, will turn to binaurals.

The makers say their market comprises 12½ million Americans: three and one-half million with a hearing-aid loss of plus 40 percent, two million with a 25 to 40 percent loss and seven million with loss in only one ear. Only 1½ million Americans wear hearing aids now.

TELEMETRY

THE VITAL LINK IN MISSILE PROGRESS

Missiles are test fired for only one purpose: to obtain data that will help build better missiles. If the test does not yield this information it must be considered unsuccessful — regardless of how well the "bird" performed.

Telemetry, consequently, assumes a vital role in the development of the missiles so necessary to our defense program. There is no other way to collect and preserve the all-important data from unmanned and unrecoverable test vehicles.

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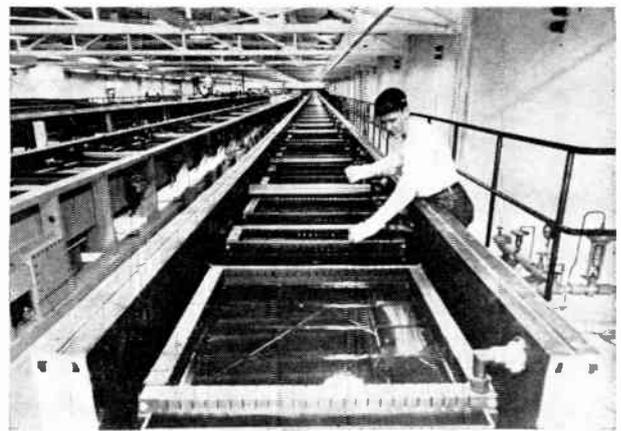
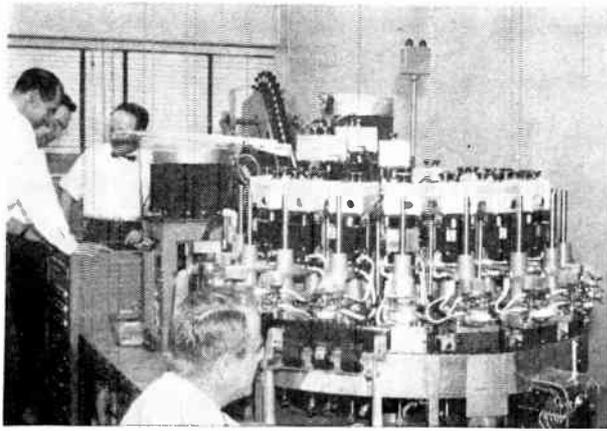


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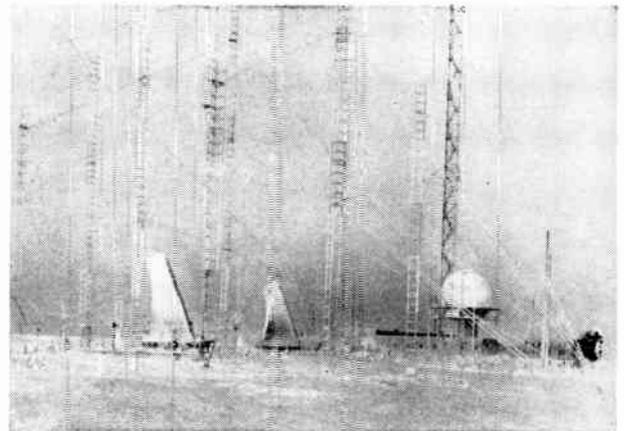
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World Radio History



Automatic manufacture of dry reed switches (upper left) and copper-steel conductors for drop wire (upper right) are among telephone operations using electronics. And military buying (like for DEW Line, right) will also mean more business for electronics suppliers as . . .



Bell System Keeps Buying

TODAY, despite the slowdown in business generally, the Bell Telephone System remains a huge and stable market for the electronics industry. The outlook this year for the system's suppliers of industrial and military electronic equipment and components is bright.

- Data-processing equipment has scored a breakthrough. The system contemplates widespread use for payroll, accounting and inventory control. A start has been made in use of data-processing gear for engineering purposes, and this may blossom within a year.

- \$323 million worth of equipment and materials was bought last year to help fulfill military prime contracts. This year military electronic subcontracting will run into many millions for: extension of the DEW Line in the Aleutian Islands; Nike-Ajax guided missile systems; Nike-Hercules ground-to-air missile system; Nike-Zeus (now an R&D antimissile missile contract); Titan ICBM radio-inertial guidance system, and other projects.

- Total purchases of materials and components last year for use in telephone manufacturing and telephone operations amounted to \$836 million.

Electronics' share of this could only be determined by a lengthy, detailed statistical analysis. But Western Electric, purchasing, manufacturing and supply unit of the system, did put its finger on \$40 million worth of purchases easily identified as electronics.

Explaining that these purchases do not include many others for electronic components and equipment, the firm told *ELECTRONICS* it spent:

About \$24 million for audio, carrier, microwave and mobile radio equipment.

About \$16 million for capacitors, resistive elements, electron tubes and semiconductor devices, including transistors.

The data-processing picture looks like this: Eight computers, two large and six medium-sized, are already in use in various plants and distribution

houses. Now on order—and the list is expected to grow—are 26 more computers, both large and medium-sized, from several companies. Conservative estimate of annual rental for 34 machines is \$5 million.

The System will be pouring more millions of dollars into the computer industry as the operating telephone companies continue to expand their data processing activities.

Present use of data-processing by WF itself includes billing, accounting, payrolls, stock inventory, calculating orders and receipts, and shop costs, and figuring manufacturing progress inventory. Eventually, data processing may be used to produce not only engineering specifications, but also to provide data for subsequent shop loading, stock control and similar operations.

Automatic manufacturing, which uses electronic measuring equipment and computers, is already making headway.

For example, there's the machine that makes glass-encapsulated dry reed switches, used by the millions in telephone gear. It uses a controlled motor drive and d-c amplifier, and about 18 commercial potentiometers. In the future, the company may consider increasing its purchases of packaged electronic control and measuring equipment as well as components for machines designed by its own engineers.

The mass spectrometer is one example of a new electronic tool finding its way into a manufacturing operation.

For example, a mass spectrometer is used in the making of electron tubes at the Allentown (Pa.) plant. As more experience with mass spectrometers is gained, it is certain that they will be found useful in more applications.

Closed-circuit television looms as another good prospect as more manufacturing in time becomes mechanized.

For example, a system already used at the Kearny Works in New Jersey, enables one man to watch two 3,000-gal hydropulper tanks in an adjoining building. Cameras look down into tanks where pulp and water are mixed, one step in making insulated material for telephone cable. Operator can thus control blending of wood pulp and water from a panel where the tv screen is located.

Test gear purchases are many and varied. For example, WF's principal military projects location at Winston-Salem, N. C. contains hundreds of thousands of dollars worth of measuring and test equipment.

More electronic gear is used in other plant labs and at the big branch labs of Bell Telephone Labora-

tories, the system's R&D unit with an annual budget of \$190 million. Half goes for military projects.

As for raw materials, Western is one of the largest users of copper in the world—100,000 tons annually. Other raw material quantities used per year are: 100,000 tons of steel, 40,000 tons of lead and 15 million pounds of aluminum. The firm is also one of the largest users of germanium, neoprene and nickel.

Soviet Rocket Gear

SOVIET SCIENTISTS have reported details of the firing of a single-stage rocket containing 1½ tons of instruments. They say it went up 294 mi.

The useful load of this IGY rocket was three times that of Sputnik II, which put Laika into orbit.

Soviet scientist Blagonravov says the rocket was successfully stabilized; all revolving was eliminated. Also, one rocket permits the use of the same nose cone and apparatus five times.

Soviet scientists say the new rocket transmitted highly useful and original scientific data—including some which upsets previously accepted American observations on electron concentrations at altitudes over 180 mi.

The official Russian announcement in Pravda said the rocket fired on Feb. 21 carried seven basic types of special instruments:

- An ultrashort-wave dispersion interferometer for measuring the concentration of free electrons in the ionosphere.

- An instrument to measure the ion composition of the atmosphere.

- Apparatus to measure the concentration of positive ions.

- An instrument to record electronic temperature.

- Ionization and magnetic manometers for measurement of air pressure.

- A solar spectrograph for registering the ultraviolet spectrum.

- A device to obtain the frequency with which particles of micrometeorites are encountered in flight. The Soviet statement said the rocket encountered the equivalent of 44 strikes of micrometeorite particles per sq meter of surface between the heights of 75 and 150 mi during flight and only 9 per sq meter at 150-180 mi.

The Russian scientists said that in contrast to American observations that electron concentrations rapidly fall off above the F layer of the ionosphere (180 mi), the Soviet rocket discovered that heavy electron concentrations continued to the peak of the flight.

Meanwhile, American scientists are planning to expand present ionospheric investigation by using ground Doppler radar to pick up signals from the ICBM Atlas.



Instrument panel on Navy F9F gets new look as services bring . . .

Controls Under Scrutiny

COCKPITS of Army and Navy aircraft will get a new look as developments emerge from the Army-Navy Instrumentation Program (ANIP). The results of this program may change both the appearance and design of much airborne electronic equipment.

Navy last month disclosed to *ELECTRONICS* hitherto classified data about the program, which dates from late 1956. The trend is clear: more sophisticated sensory devices and computers will be working behind the scenes; displays will be more pictorial, easier to grasp at a glance.

So far the program has been largely in the study and test phase. Lately activity has been stepped up: out on the Atlantic, a few Sikorski HO4S-1N Navy helicopters are going through antisubmarine maneuvers aided by improved instrumentation. Navy pilots will soon begin flight-testing an F9F with a "new-look" instrument panel (pictured).

ANIP's problem is simple to state but not to solve. Airborne instrumentation, like Gaul, is divided into three parts: sensors, computer gear and display. Add pilot and craft and you have a closed loop: display affects pilot who controls plane; sensors glean data from plane to feed either display or computer which in turn feeds display.

ANIP's object is to devise an integrated system that will give the pilot the help he needs, but not fatigue or confuse him with a maze of instruments and controls.

One quick discovery was that displays should be flexible enough to be usable with only minor variations from one craft to another. Another was that

the pilot should be required to do an absolute minimum of interpreting. Sensors and computers, as ANIP sees it, should take over the job of interpreting crude data to make it apply to specific missions.

Pilots need three kinds of data:

- **Situation (What am I doing?):** the best clues are internal and external reference, linear perspective, terrain texture, motion parallax. Pilots would also welcome a pictorial projection of the craft moving over the earth.

- **Command (What should I be doing?):** an indication of departure—and extent of departure—from a programmed path would tell the pilot enough.

- **Status (How am I doing?):** the best presentation would give the current condition of fuel supply, oxygen supply and so forth as a ratio or percentage with respect to reasonable upper and lower limits.

The ultimate computer, as ANIP's working group sees it, must take over the fixing of flight direction and commands, figuring out flight path, even taking frame dynamics and fuel consumption into account.

Present computer is essentially a three-dimensional dead-reckoning computer which can correct for position and wind whenever the craft is within range of a TACAN station. It produces an angle-of-attack and time-to-go-to-intercept as incidental results of its other computations.

Navy's Office of Naval Research and Bureau of Aeronautics were joined by Army's helicopter service to form the working group that runs ANIP. Research is monitored by ONR and administered through Douglas Aircraft and Bell Helicopter.

Russians Find Orbit With Doppler

PARAMETERS OF EARTH SATELLITE orbits have been determined with the aid of the Doppler effect by Soviet scientists. Alexander Topchiyev, scientific secretary of the USSR Academy of Sciences, said that use of the Doppler effect was part of the Soviet program of sputnik observation. A 40-mc frequency was used for maximum Doppler effect and minimum ionospheric interference.

POLAND, Czechoslovakia and Rumania will display electronic gear and components, including transistors and silicon diodes at the 1958 U.S. World Trade Fair which opens at the New York Coliseum May 7. Foreign electronics firms will also show automatic control, communications and test equipment, scientific instruments, radio and tv receivers and acoustical materials and components. Only businessmen will be admitted Monday-Thursday. Fair closes May 17.

CRYSTALS OF INTERMETALLIC compounds are being grown by Bell Telephone Laboratories according to a new technique which corresponds to the zone refining method used in growing

germanium and silicon crystals. Basic work was done on gallium arsenide, but the new floating zone process may be applicable to a variety of compounds that are thermally unstable at their melting points. Research at Bell and other labs is helping to lay the groundwork for a whole new class of semiconductor devices.

SEMICONDUCTOR REFRIGERATOR unit for biological preparations and chemical solutions has been developed by the Czechoslovakian National Physics Laboratory. Semiconductor unit fits into the cap of a 2-pint freezer flask. Institute is also working on the prototype of a food freezer unit that uses semiconductor material. It's said to be ideal for airline use.

DENSITY OF ELECTRONS at altitudes of 1,200-1,800 mi approaches that of interstellar gas. That's what radio signals from sputnik I lead Russian scientists to conclude. BESM high-speed electronic computer made the calculations based on signals heard Oct. 5, 6, and 7 at six points on a frequency of 40 mc. Data was given to annual meeting of the USSR Academy of Sciences.

TECHNICAL DIGEST

• **Microwave energy radiated by the sun** provides a convenient means for checking the accuracy of antenna azimuth and elevation readings for L and S band radars. With the transmitter turned off, the antenna is aimed for maximum solar signal pickup. The resulting readings are compared with the exact position of the sun at that time as given in the Air Almanac.

The solar signal pattern seen on a ppi indicator is called the sun strobe. It resembles that of continuous-wave interference but is easily identified because it appears only when the antenna is aimed in the direction of the sun.

This sun strobe technique is widely used by Phileo engineers for checking both search and height-finder radars. Once charts have been prepared for a particular site, sun-strobe readings can be used to evaluate system performance and atmospheric refraction as well as to calibrate antenna alignment. Radio time signals from WWV or

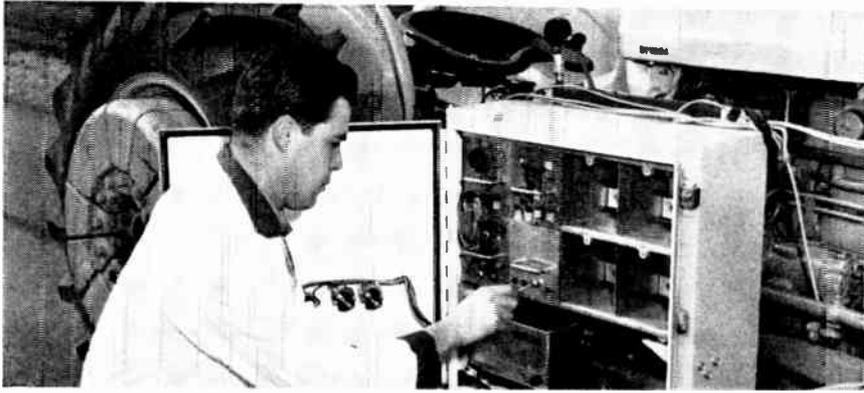
WWVH, usually available at radar sites, provide the necessary accuracy for timing.

• **Omegatron mass-spectrograph** no larger than a man's fist can be sealed to the wall of a cathode-ray tube so as to go with it through pumping, getter-flashing and final sealing operations. Residual gases can then be identified easily and quickly by positioning the magnetron between the poles of a strong permanent magnet and making tests for ions of different masses up to 50. This is done by varying the frequency of the r-f voltage applied to the spectrometer electrodes, so as to make each type of ion in turn spiral into the collector. The resulting collector current produces a pip on the scope for each ion mass present. Methane and argon were the principal residual gases found.

• **Corrosion gage for pipes** uses a radium source and Geiger-Muller

detector at opposite ends of a caliper-like gage made by Industrial Nuclonics. Because the measuring beam is the chord of a circle, it intercepts a constant amount of pipe material regardless of the radius. The calibration of the instrument is therefore correct for any pipes that touch the caliper jaws (pipes between 2 and 5 inches in diameter). Internal corrosion is indicated directly as reduced wall thickness.

• **Reusable seals for metal housings** of airborne electronic equipment can be opened up to fifteen times for repair and solder-fused again without damaging the contents, in a technique developed by General Hermetic Sealing Corp. for the Air Force. Use of a heat-reflecting baffle inside each seal keeps the inside temperature below 85 C during the soldering operation. Best results were obtained with a wraparound band heater using ceramic fiber insulation.



Proportional steering and start-stop signals provided by electronic system eliminate aching backs for tractor drivers on rugged test track

Electronics Steers Test Tractor

TRACTOR drivers can only stand brief periods driving tractors over a rugged third-mile test track. The human operator also has a tendency to throttle back on particularly rough spots of obstacle-course nature, thus invalidating test results.

Electronic guidance was therefore chosen by Ford to test their tractors. The guidance system relies on a small wire laid along the course the engineers want the tractors to take.

Test instruments are carried in a truck that accompanies the tractor undergoing examination. Its crew is protected from exposure and from the other discomforts of the test runs.

The electronically guided tractor uses a sensing antenna about 12 inches from the ground to pick up the signals from a low r-f current sent over the underground guid-

ance wire. This current is sent by a transmitter located in a building adjacent to the test track.

Part of the antenna is a reference loop at a 90-degree angle to a sensing loop. The reference loop provides a constant current against which the sensing loop can interpret the ground signal. This antenna is mechanically linked with the tractor's front wheels and swings in an arc as the tractor follows the path of the wire.

A second antenna, mounted underneath the tractor, receives start-and-stop signals that also are transmitted by the buried wire.

As long as the tractor is centered on the wire, the sensing loop is in balance with the induced current from the electromagnetic field of the guidance wire. When the tractor moves off-center, there is a voltage increase due to unbalance of

the electromagnetic field cut by the sensing loop. This voltage actuates the electronic circuits that control a servo motor belt-linked to the tractor's steering wheel. This motor turns the tractor back over the center of the wire where the voltage again becomes zero.

The electronic components are housed in a cabinet on the right side of the tractor. This cabinet is shock-mounted to protect its contents from the jolts and vibration.

There are separate chassis for the following electronic circuits: r-f amplifier, phase discriminator, anti-hunt and stabilization circuit, servo amplifier, amplidyne generator powered by a d-c motor and automatic stop control. Extra batteries of 24-volt rating provide the power for the electronic system.

Part of the electronic guidance system operates to determine the speed with which the tractor is leaving the electrical path. The rate of change of error is computed, and this information is fed to the servo motor which, through a gear reduction system, turns the tractor's steering wheel to put the tractor again on its proper course. The correction is made rapidly if the deviation from the course is abrupt, or is made slowly if the tractor is drifting off course. The anti-hunt and stabilization circuit is designed to prevent oversteering in bringing the tractor back on course.

The tractor can be brought to a stop or started from the signal transmitter or will automatically stop if the signal is lost.

MEETINGS AHEAD

May 4-7: Fourth National Flight Test Instrumentation Symposium, ISA, Park Sheraton Hotel, N. Y. C.

May 5-7: Professional Group on Microwave Theory and Techniques, PGMTT, Stanford Univ., Stanford, Calif.

May 6-8: Frequency Control Symposium, 12th Annual, U. S. Army Signal Engineering Labs., Berkeley-Carteret Hotel, Asbury Park, N. J.

May 6-8: Western Joint Computer Conf., First National Symposium on Modern Computer Design, Ambassador Hotel, Los Angeles.

May 12-14: Instrumental Methods of Analysis, ISA Annual Symposium,

Shamrock-Hilton Hotel, Houston, Texas.

May 12-14: National Aero. & Nav. Elec. Conf., PGANE, Biltmore Hotel, Dayton, Ohio.

May 13-15: Communications Section of the Assoc. of American Railroads, 34th Annual Meeting, Hotel Muehlebach, Kansas City, Missouri.

May 13-15: Radio Tech. Comm. for Marine Services, Spring Assn., Ben Franklin Hotel, Philadelphia.

May 15-15: East Central District Meeting, AIEE, Prichard Hotel, Huntington, West Virginia.

May 19-23: International Convention on Microwave Valves, Institute of Electrical Engineers, contact secretary, Savoy Place, London.

May 21-23: Energy Instrumentation Conf., Automatic Controls Applied to Gas, Electric and Steam Systems, ISA, New York City.

May 27-28: Second EIA Conf. on Maintainability of Electronic Equip., Univ. of Penn., Phila.

June 2-4: National Telemetering Conference, AIEE, ISA, ARS, Lord Baltimore Hotel, Baltimore, Md.

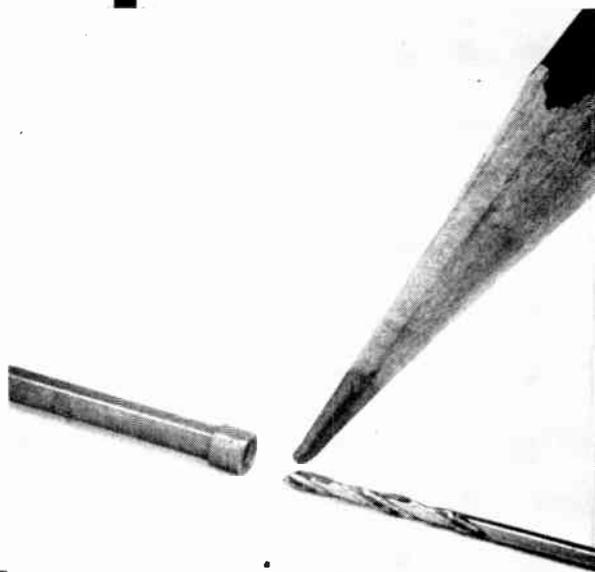
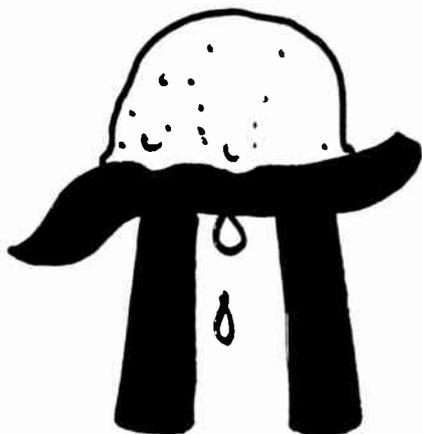
June 4-6: Armed Forces Communications and Electronic Assoc., Exhibit, Hotel Sheraton Park, Wash., D. C.

June 5-6: Second Natl. Conf. on Production Techniques, IRE, PGPT, Hotel New Yorker, N. Y. C.

June 16-18: Military Electronics, Second National Convention, Sheraton Park Hotel, Washington, D. C.

DROODLES

by ROGER PRICE



"PI À LA MODE"

This cool Doodle comes right out of an engineering textbook (it was drawn on the margin of a page, by me). Ah, when I think of those happy days I spent at Tolytec Polytech . . . seventeen of them! Then the Dean and I, in a heart-to-heart chat, decided that I'd better choose between Engineering and Doodles. It was a tough choice, but Art won out over Science.

Before I lose your attention entirely, I'd like to point out that engineering has been making strides even without my help. Take the J&L Comparator, for instance. This ingenious instrument measures and inspects all sorts of parts and objects, laterally, vertically and angularly — it also inspects by reflection and by tracing — speedily, and with precision (to .0001").

The photo above shows a tiny tube that presented a

difficult inspection problem. There's a stepped hole running the length of this little piece. Three-quarters of the time, the drills would go right out through the sides of the work pieces. The resulting scrap rate was prohibitive, and drill breakage was high.

Staging the tiny drills on a J&L Comparator, and magnifying their shadows to fill the thirty-inch glass screen, revealed the cause of the trouble: some drills had slight curvatures that had previously gone undetected. This was immediately rectified, and production continued smoothly.

Do you have a difficult inspection problem? Jones & Lamson makes the Comparator in eleven models, ranging from a 7" Bench type to a 30" floor model. For complete details, send this coupon *today*.

"The originator of machine tool standards in optical inspection"

JONES & LAMSON

JONES & LAMSON MACHINE COMPANY, Dept. 710, 539 Clinton Street, Springfield, Vt., U.S.A.

Please send me Comparator Catalog 5700, which describes the complete line of J&L Optical Comparators.

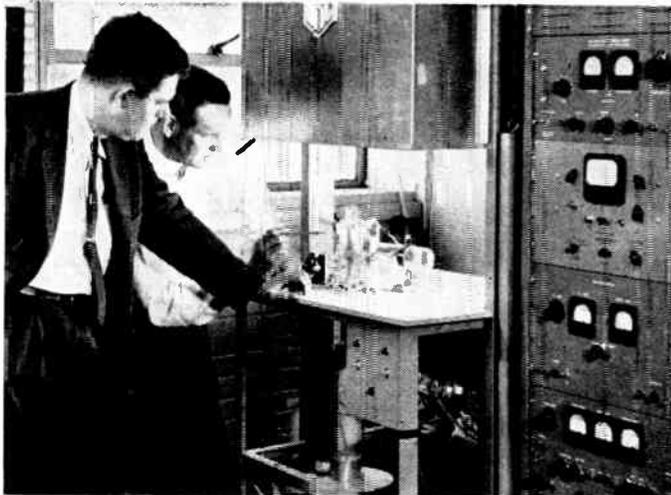
Floor Model FC-30



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company _____ city _____ zone _____ state _____

385



High-sensitivity ionization gage measures how little air the glass tube holds for . . .

Research in a Vacuum

Atmospheres of 10^{-10} mm Hg simulate outer space conditions in laboratory

EXTREMELY high vacuums are becoming increasingly important to development of advanced technologies in computers, solid state devices, power tubes, particle accelerators, missile propulsion and thermonuclear power.

Without an outer space atmosphere, research is hampered by vagrant molecular particles. National Research Corp. is operating test chambers at one 10-trillionth of an atmosphere, equal to air pressure 400 miles up.

"Interest in these extremely low pressures stems from the search for extremely clean surfaces and atmospheres which will not interfere with the passage of charged particles and high energy molecules," explains vice-president James H. Moore.

Computer engineers looking for more compact elements are trying circuits traced on monomolecular films formed by vapor deposition on exceptionally clean surfaces.

High purity materials, prepared under ultrahigh vacuums, are also basic in solid state research. One subject under investigation is the properties of a junction of dissimilar semiconductors free of

all various forms of impurities.

Ultracure gases, Moore continues, promise improved tube performance. Elimination of all extraneous gases from advanced power tubes can prevent cathode poisoning, improving performance and life.

Research into ion and photon missile propulsion requires simulation of the almost totally gas-free conditions in which these devices become operable. High power particle accelerators require higher and higher vacuums to avoid unwanted molecular collisions.

The firm has also developed a miniature version of industrial vacuum gage. It is employed to measure missile altitudes.

Laminating Film Needs No Glue

CLEAR PLASTIC FILM which laminates without adhesives to a wide variety of base materials is now in commercial production at Good-year Tire and Rubber. It will draw or vacuum form to the limits of the base material.

Expected applications in electronics include protective and decorative coatings on metals and cabinet materials, electrical papers, wrapped insulation and packaging.

The laminating form is Videne A, a thermoplastic polyester, un-oriented, amorphous and incapable of crystallizing. With few exceptions, heat and pressure will fix it to any rigid, semirigid or inextensible base material.

Etchant Keeps Renewing Self

CONTINUOUS regeneration of copper etching solutions should help cut a few corners in printed circuit production. New process is reported to save in three ways: no machine downtime while etchant is changed, more effective materials salvage and a faster etching rate.

The process, described by P. D. Garn and Louis H. Sharpe, of Bell Labs, at annual American Chemical Society meeting, employs a solution of cupric chloride in the presence of excess chloride ions. They can be regenerated electrolytically during etching operations. The electricity cost is reported to be about 20 cents for 200 sq ft of two-ounce copper.

The solution dissolves copper because the chloride forms a more stable complex with cuprous than with cupric ions. Hydrochloric acid, sodium chloride and ammonium chloride are sources of the excess ions needed.

In addition to speeding up the process, sodium chloride will take 50 percent more dissolved copper than the acid. It also has a lower vapor pressure, resulting in less fumes.

Normally, cuprous ions will become cupric at the anode and cupric become cuprous at the cathode, canceling each other out. However, decreasing the area of the cathode without changing current flow causes further reduction of cuprous ions to metallic copper. In effect it reverses the etching process.

In one small test device, the authors report, a solution with

added copper has been regenerated more than 30 times without apparent change. In commercial use, the only care necessary, they also report, would be occasional addition of water.



Engineer tightens connection on new transmit-receive tube for high power radar

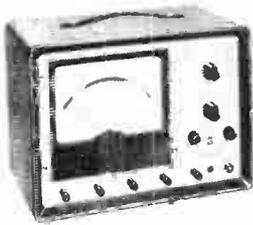
Coaxial T-R Tube In Production

TRANSMIT-RECEIVE TUBES with coaxial construction are being produced by Sylvania after four years of R&D. Military classification still covers operating details and specific application, but they are designed for low frequency, high power radar and countermeasures equipment.

General design features are its shape—a cylinder 9 inches in diameter—and the use of ceramic rather than glass window, necessitating an extremely large ceramic-to-metal seal.

A second variety of coaxial tubes has also been developed for broadband use with no cavity. A typical tube, which is 6.5 in. long and $\frac{7}{8}$ in. in diameter, handles d-c to 1,355 mc at peak power levels up to 50 kw.

in the lab, or on the line...

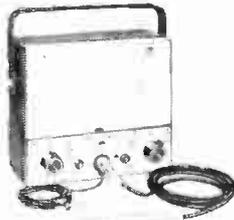


Master VoltOhmyst® WV-87B—incorporates all the essential features of the Senior Volt-Ohmyst plus 7½" meter, current ranges enabling current measurements from 10 ma to 15 amperes, zero-center scale adjustment for discriminator alignment. **\$137.50***



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Senior VoltOhmyst® WV-98A—ideal for TV, radar and other types of pulse work. Provides accuracy of $\pm 3\%$ on both ac and dc measurements. Measures directly peak-to-peak values of complex wave forms and rms values of sine waves. Features $\pm 1\%$ multiplier and shunt resistors, a 2% meter movement, $\pm 3\%$ on AC and DC voltages, less than $\pm 1\%$ tracking error. Large (6½" w.) full-vision meter provides easy readings. **\$79.50***



Ultra-Sensitive DC Microammeter WV-84B—popular choice for industrial, chemical and general laboratory applications. Designed to measure currents from 0.0002 to 1000 micro-amp. Can be used as ohmmeter to measure resistance in the order of billions of ohms. Self-contained batteries permit use for field applications. Low current drain tubes extend battery life; meter protected from accidental overloads. **\$110.00*** (less batteries)

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High-Sensitivity AC VTVM WV-74A—ALL NEW AC VTVM equipped with large 7-inch meter. Nine voltage ranges, from 0.01 to 100 volts. Features wide frequency response (within ½ db from 20 cps to 500 KC). Input resistance and capacitance with "lo cap" probe—10 megohms and 13 μf ; with direct probe—1 megohm and 95 μf . Overall accuracy $\pm 5\%$ of full scale. Built-in amplifier with gain of approximately 38 db and output impedance of 400 ohms can be used as a pre-amplifier for numerous applications. **\$99.50***

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RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.

Navy Eyes Electron Motors

Sea branch is nearing a breakthrough in turning heat to electric power by thermoelectric couples

Navy hopes to have a pilot model of a thermoelectric ship propulsion system in 12 to 18 months. Actual use in submarines or ships may come in three to five years, according to sources in Washington.

Basic unit in thermoelectric engines is an electron tube device called a thermionic converter. It converts heat into electricity by causing electrons to flow between electrodes held at differing temperatures.

Though the Navy is shying from publicizing its interest and progress, the military importance of such a system was underlined recently by Adm. A. M. Morgan, of BuShips, in testimony before the House Appropriations Committee.

"We are on the verge of a breakthrough," Adm. Morgan stated. "In the past we have had such thermocouples but their efficiency has been low . . . we now have a field of endeavor which if successful will enable us to get efficiencies comparable to those obtained with conventional power plants. In submarines, the technique would eliminate almost all noisy machinery."

Thermoelectric engines could also be cheaper, if not in installation costs, then in reduced maintenance. Further savings could come from efficiencies higher than those achieved in conventional small power plants.

The Navy is also investigating methods of driving

ships without propellers. One possible method is electrically charging the water. The aim is reportedly to complete this research by the time the thermoelectric engines are usable.

Air Force is considering thermionic converters to change jet exhaust heat into electricity to run aircraft equipment. Army is investigating it as a power source for field communications. The Russians have been using kerosene-fired thermocouples to power radios.

In addition to the military development, at least two projects with commercial overtones are going on.

Work at GE was reported in *ELECTRONICS*, Dec. 10, '57. Two professors at MIT also report progress (*ELECTRONICS*, Apr. 11, p 18). All hope eventually to attain a 30-percent heat to electricity conversion efficiency.

The working model at MIT is similar in principle to GE's. Two plates, 1/1,000 of an in. apart, are placed in a tube. One plate is heated to 2,200 F and the other to 1,000 F. Electrons become the "working fluid" as they are boiled off the hot plate and collected on the "cold" plate.

Present efficiency of 12 percent is reported with the model at MIT. Efficiency higher than 30 percent may result from a design change which employs fields to control electron flow.

Twelve percent may already be an adequate efficiency for certain types of operations. A bonus in lowered maintenance of moving parts and unattended operation is expected. The converter can yield five to 15 kw per cubic foot of plant volume.

MILITARY ELECTRONICS

- New microwave radar low altitude altimeter for helicopters that can hook in with the autopilot and hover at a desired altitude is ready for delivery to BuAer by Sylvania. Maximum error at altitudes below 40 ft is ± 2 ft; error at altitudes between 40 ft and 1,000 ft stays within five percent of the correct terrain clearance. Not confined to helicopters, the AN/APN-117 is suitable for any low altitude craft, both military and civil. Minimum operating life is 2,000 hrs.

- Ground-handling equipment re-

quired in USAF missile operations will amount to \$889 million in fiscal year 1959, \$286 million more than in fiscal 1958, according to Aircraft Industries Association.

- "Approximately 50 percent of the Air Force's procurement dollars are used to pay the bill for electronic devices," said Brig. Gen. B. H. Warren, deputy director for weapons systems of the Air Materiel Command in a recent speech before the Dayton, Ohio, Electronic Equipment Manufacturers Representatives.

CONTRACTS AWARDED

Sperry is awarded a new \$12,821,000 contract by BuOrd for Mark III computers and associated equipment for the Talos guided missile system. The computer implements the function of target designation, acquisition, tracking, launcher control, missile control and display for rapid and accurate acquisition of a target by the missile. This contract is in addition to the recent \$63 million contract for production of major components of the Talos and Terrier guided missiles systems (*ELECTRONICS*, Apr. 18).

Titeflex sells components for radio-

shielded ignition harness to USAF for use on Pratt & Whitney R4360 engines amounting to \$316,000.

Aircraft Armaments is awarded a \$1,877,453 contract by the Airways Modernization Board for an air traffic control simulator designed to speed up experiments and modifications leading to modernization of the nation's aviation facilities.

RCA sells electron tubes and triodes to the Dayton AF Depot under \$461,720 contract.

Raytheon gets a \$1,108,000 contract with Dayton AF Depot for airborne countermeasures sets, AN/AIQ-25.

Bomac Labs sells electron tubes to the Electronics Supply Office, Great Lakes, Ill., under \$630,660 contract.

Raytheon supplies the Dayton AF Depot with electron tubes and magnetrons totaling \$3,060,000.

RCA Service gets a \$1,165,007 contract with Air Materiel Command for AC&W on-site maintenance.

Specialties, Inc., Long Island, N. Y., will supply BuAer with angle of attack systems transmitters under \$639,517 contract.

McDonnell Aircraft gets a USAF order for 84 more electronic-laden F-101B Voodoo interceptors totaling \$58,140,000. A total of \$355,795,849 Voodoo's have been ordered to date. Fire control system in the Voodoo launches the air-to-air atomic rocket, Genie.

Sylvania gets a \$23 million contract boost for expanded production of the electronic countermeasures system total to \$54 million to date.

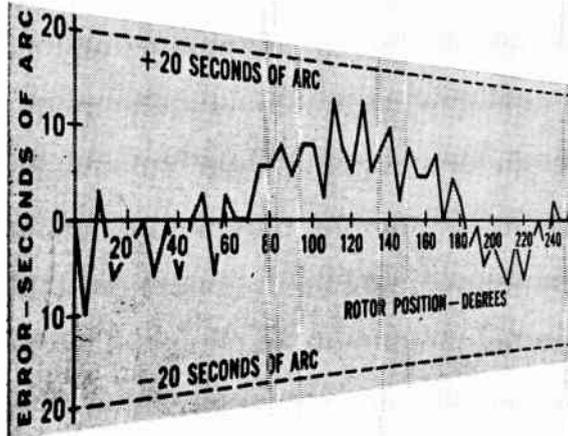
In addition, Sylvania gets a \$4½ million boost from Boston Army Ordnance District for expanded development of Plato, Army's anti-missile missile system for field troops (ELECTRONICS, Feb. 21, p. 49).

**SYNCHRO
ACCURACY**

20

**SECONDS
OF ARC**

**ELIMINATE MULTI-SPEED SERVOS
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NEW ULTRA-PRECISE SIZE 25 SYNCHROS

Extremely precise data transmission is possible through the use of Kearfott's Size 25 synchro resolvers. The inherent precision of these units provides a three sigma accuracy of approximately 35 seconds in a typical 3 unit string without the use of auxiliary equipment. Ruggedly constructed of corrosion resistant materials, they possess the required reliability for all missile applications. Available as transmitters, differentials and control transformers with a maximum error from E.Z. of 20 seconds arc.



SIZE 11 SYNCHROS

Size 11-2 phase 4 wire synchro resolvers for data transmission combine the advantages of small size with high accuracy. Corrosion resistant materials are used in the construction of these units. Available as 60X transmitters, differentials and control transformers with a maximum error from electrical zero of 3 minutes arc. Standard 3 wire synchros are available from production with 5, 7 and 10 minute maximum error from E.Z.

ENGINEERS
Challenging opportunities at Kearfott in advanced component and system developments.

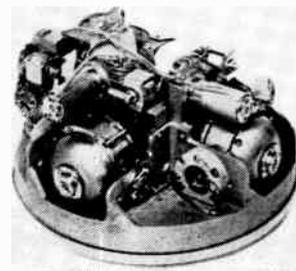
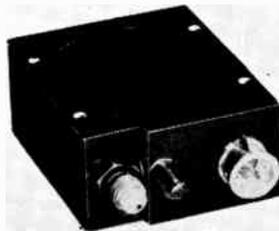
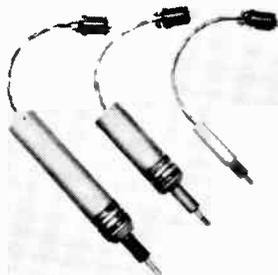
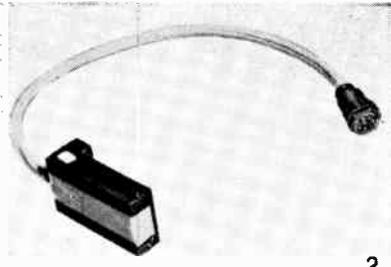
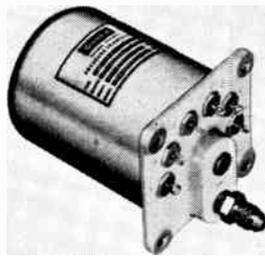


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4. THE GARRETT CORP.
Tiny Pressure Transducer
5. CLARY DYNAMICS
Gyro Transducer



Emphasize Accuracy

TRANSMISSION of information, or data, plays a key role in man's conquest of his environment. Transducers are an essential element in any data transmitting system. Shown here are some of the latest models. All feature high accuracy.

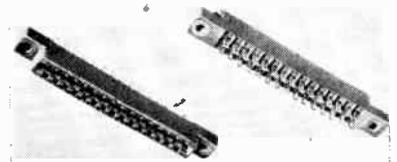
G. M. Giannini & Co., Inc., 918 E. Green St., Pasadena 1, Calif., (50), announces model 451212 potentiometer output pressure transducer. Featured are a 2,000 wire (0.05 percent) resolution and accuracy within one percent of reading. It has a wide variety of airborne and missile applications.

Recently developed by Sterling Precision Corp., 17 Matinecock Ave., Port Washington, L. I., N. Y., (51), is the T833 transducer. The differential transformer type pickoff may be adapted for use as an electromechanical transducer for precise measurement of both linear and angular displacements.

Daytronic Corp., 216 S. Main St., Dayton 2, Ohio, (52), offers a new series of differential transformer transducers designed for linear motion or displacement measurement. Extreme sensitivity and stepless resolution provide accurate measurement of motions as small as 0.000001 in. or over in ranges as large as 0.4 in.

Now available from AiResearch Mfg. Div., The Garrett Corp., 402 S. 36th St., Phoenix, Ariz., (53), is a 5 oz pressure transducer capable of withstanding 50 g shock. The 50 psi units are designed to deliver long life and accuracy under high humidity, and in temperatures from -65 to 165 F.

Clary Dynamics, 408 Junipero St., San Gabriel, Calif., (54), has in production a highly accurate gyro transducer for control of airborne vehicles or instrumentation telemetry systems. The hermetically sealed unit weighs 19½ lb, including caging mechanisms, inverter and radio-noise filters.



P-C Connector floating type

VIKING INDUSTRIES, INC., 21343 Roscoe Blvd., Canoga Park 2, Calif. To insure perfect alignment between printed circuit board and connector, the receptacle is furnished with floating bobbins which compensate for any misalignment between printed board and receptacle.

When the misaligned board strikes the chamfer located at each end and along the inside edge of the receptacle cavity, the receptacle shifts on its bobbins and allows the board to enter the cavity. Viking p-c connectors are available in 10, 15, 22 and 28 single row contacts and 30 and 44 double row contacts. The self-alignment floating bobbins feature is optional. Circle 55 on Reader Service Card.

For more information use READER SERVICE CARD

Space-saving Pots wire-wound units

CLAROSTAT MFG. CO., INC., Dover, N. H. Series 57 precision wire-wound potentiometers are designed to meet the demand for top performance in minimum space. They measure $\frac{1}{2}$ in. in diameter and weigh only 0.25 oz.; rated at 1.5 w at 40 C.



Availability in resistance values is up to 40 K ohms, and resistance

tolerance of ± 10 percent standard or to ± 3 percent special.

They feature welded connections; thermally compatible cover with sturdy terminals molded in place; dielectric strength of 1,000 v a-c for 1 minute at atmospheric pressure; limited or continuous rotation, with torque of less than 0.5 oz.-in. **Circle 56 on Reader Service Card.**

Pi Line Attenuator broad band

ANTENNA & RADAR RESEARCH ASSOCIATES, One Bond St., Westbury, N. Y., announces a new series of microwave attenuators. These π line attenuators are extremely broad band (three to one bandwidth) and feature high continuously variable attenuation with

minimum insertion loss and low vswr. They are 5 in. in diameter covering bands of 0.8 to 2.5 kmc and 2.0 to 6.0 kmc. Minimum insertion loss is 0.2 db and full insertion loss is at least 30.0 db over the full band.

The units are applicable in all systems where variable r-f attenuation is required. **Circle 57 on Reader Service Card.**



Crystal Filters in four bandwidths

HYCON EASTERN, INC., 75 Cambridge Parkway, Cambridge 42, Mass., has announced a new series of miniaturized crystal filters in four bandwidths at a center frequency of 10.7 mc. The filters permit single conversion with high selectivity in the early stages of the receiver close to the antenna. Test installations revealed marked reduction in receiver desensitization



as a result of this feature. Designed to meet present and future FCC selectivity requirements, this entire

family of filters are interchangeable both mechanically and electrically to simplify production and eliminate the possibility of receiver obsolescence.

Shape factor is 2:1; insertion loss, approximately 1 db; size, 2 $\frac{3}{4}$ in. by 1 in. by 1 $\frac{1}{2}$ in. Now available are the model 10 MA with a 6 db bandwidth of 30 kc, model 10MB with a 15 kc bandwidth, model 10ME with a 6 kc and model 10MF with a 3.5 kc bandwidth. **Circle 58 on Reader Service Card.**



Digital Voltmeter high reliability

KIN TEL, a division of Cohn Electronics, Inc., 5725 Kearny Villa Road, San Diego 12, Calif. Model 401 d-c digital voltmeter features a single plane, wide angle readout;

0.01 percent or 1 digit accuracy; automatic ranges covering from 0.0001 to 999.9 v; and automatic, continuous standard cell calibration. Complete description, specifications and prices are given in bulletin No. 19-2. **Circle 59 on Reader Service Card.**

D-C Power Supply precision regulated

UNIVERSAL ELECTRONICS CO., 1720 22nd St., Santa Monica, Calif. Model L3520A precision regulated d-c power supply is continuously



variable from 0-350 v, at 0-200 ma, for highly versatile application in laboratory or industry.

Regulation is 0.1 percent for 10 percent line or 0 to full load change. Transient response is 1 millisecond; ripple, 1 mv. A bias source is avail-

able at 0 to -150 v, 0 to 5 ma. There is also a filament source, 6.3

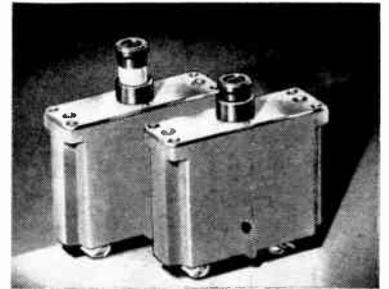
v a-c, c-t, 0-10 amperes. Line input range is from 105 to 125 v a-c at

50 to 400 cps. Circle 60 on Reader Service Card.

Circuit Breaker thermal type

METALS & CONTROLS CORP., Attleboro, Mass. The Klixon D6752-5 circuit breaker is especially designed to compensate for ambient temperature. Manufactured for aircraft applications, it will carry rated current at 250 F, and 115 per-

cent of rating at 77 F and -60 F. The new breaker is a push-pull, indicating type constructed to withstand military environmental conditions of shock, vibration, corrosion and humidity. Maximum weight is 0.2 lb. Standard life is approximately 10,000 cycles. Circle 61 on Reader Service Card.



Chokes epoxy encapsulated

WATERS MFG., INC., Boston Post Road, Wayland, Mass., has brought out a new family of epoxy encapsulated chokes, covering a wide range of inductances from 0.1 μ h to 200.0 mh. One type features a flat side for mounting on printed wiring boards with axial leads. The flat side also provides an index

surface for automation uses in various industries. For heavier components, additional leads are provided for mechanically securing encapsulated chokes to printed boards, to meet extreme vibration and shock requirements.

Also available is a tubular style, with leads extending from one end for printed wiring boards or conventional circuit applications with



high temperature requirements. Circle 62 on Reader Service Card.

Tube Shield Insert full-contact

ATLAS E-E CORP., 47 Prospect St., Woburn, Mass., has introduced a new full-contact insert for miniature tube shields. Manufactured to meet MIL-S-19786A (Navy), this insert has a unique design of oppositely oriented triangles which gives an almost contiguous contact with the tube envelope.

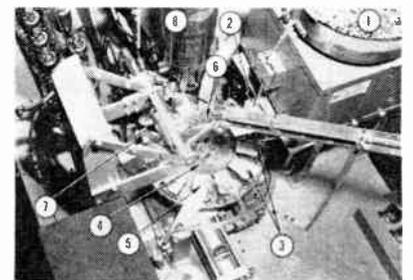


The new insert gives a much better thermal path from tube to shield, hence much lower bulb temperatures are now possible. Another advantage of this design is ready adjustment to the wide variation in tube and shield diameters. Under conditions of extreme shock and vibration, its spring quality provides excellent cushioning for the tube. Circle 63 on Reader Service Card.

Diode Sealer completely automatic

RAYTHEON MFG. CO., Waltham, Mass., has developed a completely automatic diode sealer which produces 1,500 finished diodes per hour. In operation diode cans feed from vibrating hopper (1), down through an escapement (2), into

hollow lower electrodes (3) in the dial feed (4), where they are filled with silicone oil (5). Diode stems feed from track (6) into fixture (7), which inverts the stems and inserts them into cans nested in lower electrode. Assembly is then hermetically sealed by welding in model II welding head (8). Circle 64 on Reader Service Card.



Diode Tube gas trigger type

THE VICTOREEN INSTRUMENT CO., 5806 Hough Ave., Cleveland 3, Ohio, announces a new microminia-

ture cold cathode gas trigger diode tube. It is said to be ideal for electronic and missile applications where weight, physical size and high G considerations are involved. It can be used for isolation pur-



poses, electronic switching, RC timing circuits, relaxation oscillators, and the like.

A typical model of the new diode

series, model TAA-113, for example, has the following characteristics: nominal firing voltage, 113 v; leakage resistance at 95 v,

5 by 10^{10} ohms; acceleration, to 20,000 G; energy transfer, 3,000 ergs. **Circle 65 on Reader Service Card.**

D-C Amplifier transistorized

ELECTRO INSTRUMENTS, INC., 3794 Rosecrans St., San Diego 10, Calif. Model A-12 d-c amplifier is completely transistorized and equipped with a self-contained solid state power supply. Band-pass extends

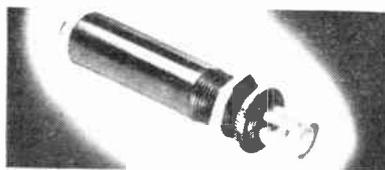


from d-c to 50,000 cps. Noise is less than $8 \mu\text{v}$ wideband. Standard

drift rates are expected to be less than $2 \mu\text{v}$ per week. Packaged for high density use, the A-12 mounts eight across in standard 19 in. rack panels. The unit provides gains of zero to 1,000 times and is used for operational, potentiometric, and differential input applications. **Circle 66 on Reader Service Card.**

Panel Components three new types

TRANSISTOR ELECTRONICS CO., 3357 Republic Ave., Minneapolis 26, Minn., has developed a new line of computer control panel components. The Echo-Lite is a push button with a NE-2 neon



bulb enclosed; the Memo-Lite, a subminiature thyratron indicator

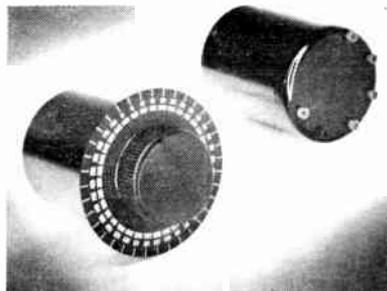
for transistor circuitry; and the Transistor-Lite, a transistor controlled neon lamp circuit. Each is housed in an anodized aluminum tube of $\frac{1}{2}$ in. diameter, 2 in. long. The gold plated terminal connections are for A-MIP series 53 taper pins. **Circle 67 on Reader Service Card.**

Synchro Bridge miniaturized

THETA INSTRUMENT CORP., 48 Pine St., East Paterson, N. J. Introducing less than 8 seconds-of-arc error, the model SB-12 will measure the angular position of a servo systems as well as the electrical error of synchros and resolvers.

It passes all military environmental tests without deterioration in performance. During three million revolutions of the dial, its basic error is guaranteed not to exceed eight seconds.

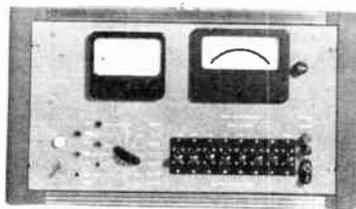
This miniaturized instrument lends itself toward panel-mounted applications. **Circle 68 on Reader Service Card.**



Transistor Tester six voltage ranges

TRANS ELECTRONICS INC., 7349 Canoga Ave., Canoga Park, Calif. Physically, model BT5001A was designed for unskilled operators in quantity testing, as well as for the skilled laboratory technician.

Electrically, the tester measures



the saturation currents of diodes and transistors. Six voltage ranges (0-10; 10-50; 50-100; 100-250; 250-500; 500-750) are presettable anywhere within their range.

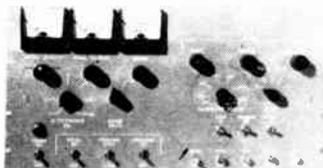
Fourteen current ranges with keyboard selectivity permit current measurements from 10^{-9} to 10^{-3} amperes full scale. **Circle 69 on Reader Service Card.**

Pulse Programmer simulates target

RENANCO, 128 Broadway, Santa Monica, Calif. The model RP175 radar pulse programmer realistically simulates radar target characteristics. The unit will program a target over a range of 30 nautical miles at

velocities from 0 to 5,000 fps and accelerate the target range position, at constant accelerations, from 0 to 30 g's. It may be externally triggered or operated internally over a prf range of 400 to 2,000 pps.

Pulse width is adjustable from 0.2 to 1.0 μsec ; 15 v positive or negative pulses into 100-ohm load

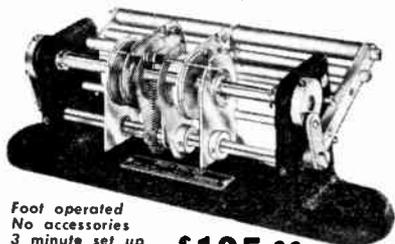


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PIG-TAILORING provides: • Uniform component position • Uniform marking exposure • Miniaturization spacing control • "S" leads for terminals • "U" leads for printed circuits • Individual cut and bend lengths • Better time/rate analysis • Closer cost control • Invaluable labor saving • Immediate cost recovery.

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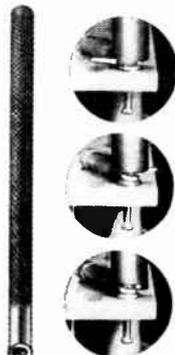
"SPIN-PIN"[®]

Close-up views of "SPIN-PIN" illustrate fast assembly of tailored-lead wire to terminal.

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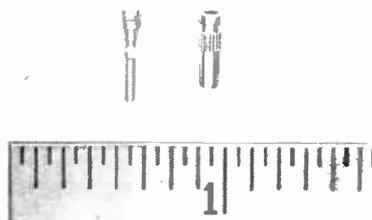
are available. The target pulse may be mixed with radar i-f noise and amplitude modulated up to 1,000 cps. Any of the stated parameters may be changed or new features incorporated. Circle 70 on Reader Service Card.



Lab Tool for waveform study

TRANSDATA, 1844 Bridgen Rd., Pasadena, Calif., announces a waveform translator which provides the means for accurate plotting of waveforms to 20 kc on conventional X-Y plotters. Static X-Y measurements may also be made.

The unit is designed to accept signals from any oscilloscope, but may be used independently. An intensity strobe allows the operator to observe instantaneous plotting position on the scope trace. Circle 71 on Reader Service Card.



P-C Terminals satisfy MIL specs

CAMBRIDGE THERMIONIC CORP., 445 Concord Ave., Cambridge 38, Mass. Two new printed circuit terminals are precision-machined in brass and finished with copper flash and a 0.0003 in. tin-lead solder plating. The No. 2228, with a split end, is $\frac{3}{16}$ in. long when mounted ($\frac{3}{8}$ in. overall length). No. 2420 is $\frac{3}{16}$ in. long when mounted ($\frac{3}{8}$ in. overall length). Both are push fit with over knurl and fine straight knurl. Circle 72 on Reader Service Card.

Literature of

MATERIALS

Ferramic Material. General Ceramics Corp., Keasbey, N. J. Bulletin 324 describes ferramic S-4 material in the I'394 size for magnetic cores to be used in high-speed coincident current memory. General, electrical and mechanical engineering data are included as well as switch time curve. Circle 73 on Reader Service Card.

COMPONENTS

Bobbin Cores. G-L Electronics, 2921 Admiral Wilson Blvd., Camden 5, N. J. A four-page folder illustrates and describes a line of precision-made bobbin cores for use in digital data processing systems. Included in Bulletin TB-103 are data on the G-L magnetic materials available. Ordering information is also given. Circle 74 on Reader Service Card.

Data Display Indicators. Union Switch & Signal, Division of Westinghouse Air Brake Co., Pittsburgh 18, Pa. Catalog 1015 is a 12-page technical publication describing construction, operation, specifications and typical applications of a line of versatile, plug-in indicators for data display, storage and transfer. Circle 75 on Reader Service Card.

R-F Filters. Microphase Corp., Box 1166, Greenwich, Conn. An 8-page booklet contains illustrated descriptions of a line of r-f filters. Included are low-pass, high-pass, band-pass, diplexer, triplexer, multiplexer and constant-impedance types. Circle 76 on Reader Service Card.

EQUIPMENT

Converter and Frequency Changer. Carter Motor Co., 2711 W. George St., Chicago 18, Ill. Two new products are covered in

the Week

bulletin 258A. One is a d-c to a-c converter which offers reliable heavy-duty performance for applications requiring a high capacity output of 115 or 230 v a-c, 50 or 60 cycle, single or 3 phase. The other is a frequency changer which produces 60 cycle a-c output from 25 to 400 cycle input. Circle 77 on Reader Service Card.

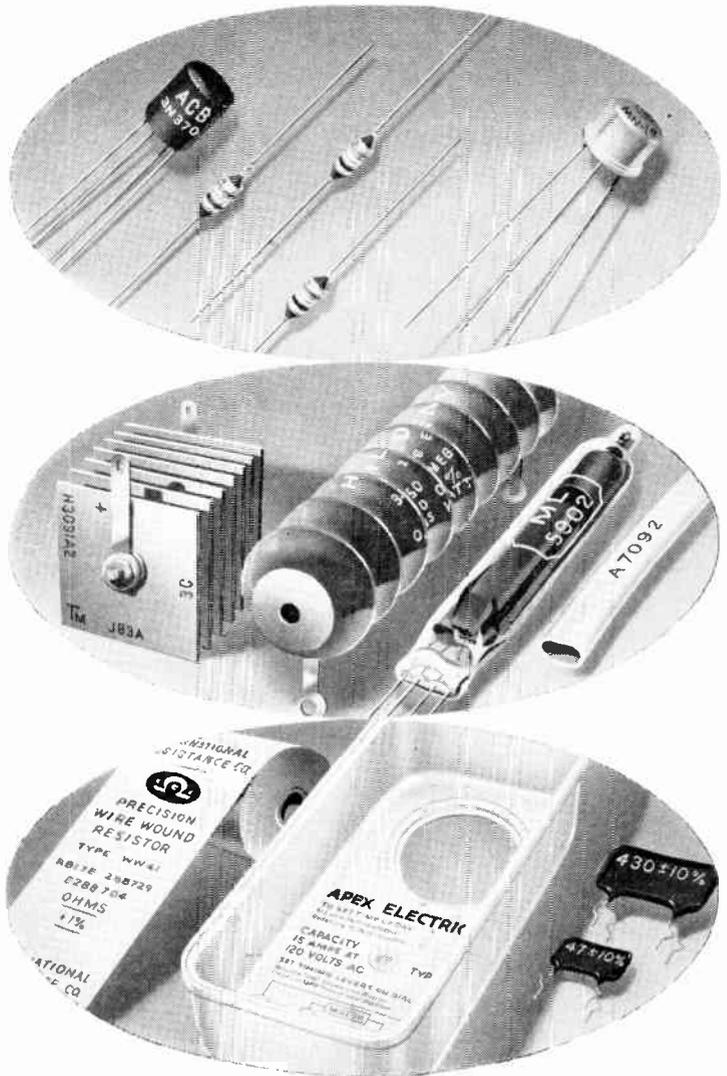
Servo Systems. Waldorf Instrument Co., Huntington Station, Long Island, N.Y., announces a new file folder and specification sheets on the presently available Micromation products. Included are plug-in servo repeater systems and subminiature servo amplifiers. Circle 78 on Reader Service Card.

Vertical Interval Signal Keyer. Telechrome Mfg. Corp., 28 Ranick Drive, Amityville, L. I., N. Y., has available data on the model 1008-A vertical interval signal equipment which permits tv test and control signals to be transmitted simultaneously with program material. Purpose and advantages, general description and specifications are given. Circle 79 on Reader Service Card.

Wide Range Pulse Generator. Burroughs Corp., 1209 Vine St., Philadelphia 7, Pa., Type 1006 wide range pulse generator is illustrated and described in a recent technical bulletin. The unit discussed produces a stable source of pulses in eight overlapping frequency ranges up to 4.5 mc. Circle 80 on Reader Service Card.

FACILITIES

Inertia Switch. Inertia Switch Division of Safe Lighting, Inc., 527 Lexington Ave., New York 17, N. Y., has announced a reprint telling of its products and services. Of interest to potential users of inertia switches is the principle mentioned which makes possible a great variety of products. Circle 81 on Reader Service Card.



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MARKEM

Progress in British Missiles

Two missiles are operational, two near-operational. Several long-range ones are under development

BRITAIN'S missile inventory is growing. At least two of her missiles are operational out of 12 that are known or believed under development. Two more are near-operational.

Bloodhound, an operational ramjet antiaircraft missile, is in production for the RAF. This month trials will begin at an RAF missile station. Bloodhound is a semiactive homing missile; it has a dish receiver in its nose which picks up radiation reflected from a radar-illuminated target. An airborne computer determines optimum trajectory for a collision course.

Seaslug, a sea-to-air beam-rider antiaircraft missile is in production for the Royal Navy. Firestreak, a 50-mi infrared homing missile is reported to be the

last of Britain's air-to-air missiles developed. Acceptance trials have been completed and production deliveries are scheduled during 1958.

Thunderbird, a land-based, semiactive radar-guided antiaircraft missile, has been ordered for both Army and RAF on a preliminary basis.

A long-range missile with a celestial guidance system is believed to be under development by English Electric. De Havilland Propellers is working on an IRBM, powered by a Rolls-Royce engine believed developed from a North American Aviation design. Sperry is thought to be working on the guidance system. Another long-range missile is known to be under development by Bristol Aeroplane Co.

Other firms developing missiles: Hawker-Siddeley, a shipboard offensive missile; Vickers Ltd., an air-to-ground offensive missile in the form of an air-launched automatically controlled bomb carrier aircraft; Avro Ltd., a guided stand-off bomb for the V-bomber weapon system. Chart below lists operational and near-operational missiles.

Name	Category	Range Mi	Prime Contractor	Guidance Contractor	Type Guidance	Remarks
Operational						
Seaslug	sea-to-air	..	Armstrong-Whitworth (Hawker Siddeley Group)	GE Co. of England and Sperry	beam rider	Production, Navy
Bloodhound	land-to-air	..	Bristol Aeroplane Co.	Ferranti Ltd.	Semiactive radar-homing	Production, RAF
Near-Operational						
Firestreak	air-to-air	50	De Havilland Propellers Ltd.	Mullard	infrared homing	1958 delivery
Thunderbird	land-to-air	..	English Electric	English Electric	semiactive radar-guided	Prelim. prod. orders
Red Dean	air-to-air	..	Vickers	Abandoned
Fireflash	air-to-air	..	Fairey Aviation Co.	Plessey	radar homing (E. K. Cole)	Training use; superseded by Firestreak

DEVELOPMENTS ABROAD

• Japanese computer activity is stepping up. Tokyo Shibaura Electric (Toshiba) and Tokyo University are jointly working on a \$300,000 automatic computer called TAC. Project may be completed this fall. TAC will have two storage systems: 1,000-word internal storage on a magnetic drum or 2,000-word core matrix, and an external 30,000 word storage if magnetic tape is used. Also, Toshiba has sent its simplified an-

alog computer, TOSAC, to the Brussels World's Fair. Meanwhile, the Mark IV digital computer (ELECTRONICS, Apr. 4, p 50) is being programmed for plant control by the machinery laboratory of the Ministry of International Trade and Industry. Nippon Electric, first to put the government-developed Mark IV into production, now expects its first production units in May, and a total of 3,000 units by the end of 1958.

EXPORTS and IMPORTS

NATO has opened four electronics projects to U. S. bidding. For one project France will get \$9.55 million worth of communications gear: 168 tropospheric antenna assemblies with 20-meter reflectors, dual polarized feed horns, support and feed lines; 100 antenna assemblies are standard type, 68 ruggedized. Another French project, estimated to cost \$621,000, calls for 32 tropospheric 1-kw power an-

plifiers. An Italian project calls for construction and installation of two radar units. In Greece some \$76,000 will be expended for supply and installation of three terminal frequency shift radioteletypewriter units.

West German transport ministry awarded a \$950,000 order for two radar systems to Philips of Holland. The installations will be used at Hamburg and Bremen to direct ships in the mouths of the Elbe and Weser rivers. Another radar contract, awarded by the Hamburg Harbor Commission, went jointly to Decca Radar of London and Telefunken. This will cover four radar stations for Hamburg harbor and adjacent stretches of the Elbe river. Later, the commission plans a radar-link system bringing the entire harbor area under observation at a central pilot station.

In Israel a \$600,000 electronics firm is being planned with French financial and technical assistance. Koor Co. of Tel Aviv, which controls nearly 30 enterprises, and an unidentified French firm are behind the venture. The Israeli government is expected to offer financial support too.

French air ministry has purchased four giant environmental test chambers at a cost of \$140,000 from Tenney Engineering, Union, N. J., making a total of 13 test units bought from the firm by the French government.

Yugoslav broadcast authorities have ordered \$150,000 worth of equipment from the British Marconi Co. for a 353-mi television link between Belgrade and Ljubljana. Equipment operates in the 1700-2300 mc range and uses an all-traveling wave tube technique in both terminal and repeater stations.

In Italy Societa Mial of Milan announces it has signed an agreement with Centralab division of Globe Union Corp. to manufacture and sell Centralab ceramic capacitors in the European market.



• R-F RECEIVER DESIGN • INERTIAL NAVIGATION

**Two of many areas in Avionics
in which Bell Aircraft has openings
for qualified electronics engineers**

Particularly good opportunities are now available for engineers with radio frequency experience in the 100 kilocycle to 35,000 megacycle range with emphasis on transistorizing of circuits... and for those with experience in inertial instrumentation design and evaluation.

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Reins Tightening for F-M

Final deadline for stopping simplex activities passes. Check shows 25 to 30 stations still hanging fire

END OF THE ROAD for simplexing is in sight nearly three years after FCC began granting Subsidiary Communication Authority allowing f-m stations to provide commercial background music service to bolster station income.

Upon receipt of Sub Com Authority, some stations began programming exclusively for paying subscribers. A subaudible tone sounded before and after announcements was used to key subscriber receivers on and off so that only music reached the paying customer.

The FCC's feeling is that this practice, which is

called simplexing by the f-m operators, does not meet the intent of applicable broadcast regulations.

Stations were ordered to multiplex. This means they are now required to program public consumption broadcasts on main channel, and use only a subchannel for subscriber service. First deadline to multiplex was July 1956.

Scarcity of multiplex equipment at that time resulted in another year's grace period. In July 1957, a second stretch to January of this year was allowed with condition that no new simplex permits would be granted.

At the beginning of this year, final deadline was set at March 31. Since that date, extensions have been given in accordance with individual station circumstances. Check this week shows about 25 to 30 stations still hanging fire.

FCC ACTIONS

- Amends amateur frequency rules effective May 10 to preclude use of 1,875 to 1,925-ke band to allow expansion of Ioran facilities. Hams can share 1,800-1,825, 1,975-2,000 ke with Ioran.

- Grants permission to Mackay Radio to set up Telex rates and regulations from U.S., Honolulu to Japan.

- Invites comment by May 23 on proposed rule making to amend Aviation Services rules to establish a new class of station for use by planes and ships engaged in rescue operations and searches. Stations will operate on 121.6-mc band.

- Invites comment by July 11 on information needed in considering marine safety for shipboard stations.

- Grants application of Manchester Broadcasting for new a-m station, 1,230 kc, 250 w in Manchester, Conn.

- Affirms grant to Borough of Lemoyne, Pa., of radio authorization in the Fire Radio Service.

- Grants transfer of control of WESC, WESC-FM, KD-2080, Greenville, S. C., from C. K. Mitchell to Broadcasting Co. of the Carolinas; consideration \$267,000.

- Notifies hams that K and W prefixes for call signs will soon be used up. New system will assign WN, WA or WV to future users outside continental U.S.

- Grants permission to Press Wireless to establish rates and regulations for point-to-point program channel service between N. Y. and San Francisco, ships, aircraft and temporary mobile and fixed stations.

- This month marks the tenth anniversary of the Joint Technical Advisory Committee. The eight-man body was established by Institute of Radio Engineers and Electronic Industries Association to aid FCC.

JTAC has been a strong factor in channel allocations and color tv standards. A major group project was "Radio Spectrum Conservation" published in 1952. It's now a standard industry handbook.

STATION MOVES and PLANS

KEEL, Shreveport, La., files for renewal of license.

WJBM, Brookhaven, Miss., seeks modification of license to go from unlimited to specified hours.

WCRE, Cheraw, S. C., requests voluntary assignment of license to Pee Dee Broadcasting Co.

KBIC-TV, Los Angeles, asks for construction permit to replace expired c-p which authorized a new station.

WNEP-TV, Scranton, Pa., applies for c-p change in name from Union Broadcasting to Northeastern Pennsylvania Broadcasting, Inc.

KLSE, Monroe, La., Louisiana State Dept. of Education files for educational tv station.

WOV, New York, receives word that application to specify New York, N. Y., and Carlstadt, N. J., as station location will require a hearing.

WTVD, Durham, N. C., receives permission to move transmitter to

about 32 miles southeast of Durham, 10 miles southeast of Raleigh, raise antenna height from 1,010 to 1,510 ft.

WWEZ, New Orleans, La., transfers license assignment to Mid-Continent Broadcasting; consideration \$490,000.

KUEQ, Phoenix, Ariz., receives license grant for a-m station.

WGIG, Brunswick, Ga., slates increase in daytime power, installation of new transmitter.

WPGC-FM, Oakland, Md., gets extension of authority to remain silent until June 20.

WGTC, Greenville, N. C., receives permission to sign off at 5 p.m., daily for six months.

WBLA, Elizabethtown, N. C., plans change in facilities and installation of new transmitter.

KLFY-TV, Lafayette, La., gets completion date extension to Sept. 24.

KEDO, Ontario, Cal., receives e-p to change antenna/transmitter location, install new composite antenna, raise erp to 1 kw, drop antenna height to under 415 ft.

WFZL, Richmond, Va., gets e-p to install new antenna and transmitter for auxiliary purposes only.

WCLR, Torrington, Conn., receives approval to operate transmitter by remote control.

KFBI, Wichita, Kans., files for voluntary assignment of license to Jayhawk Broadcasting Corp.

WHICN, Hartford, Conn., asks voluntary relinquishment of control and Subsidiary Communication Authorization by T. M. Hastings by sale of stock to C. M. Burnhome.

WXYZ, Detroit, Mich., starts construction of \$4-million facility to house radio and television activities. Completion date is set for May, 1959.

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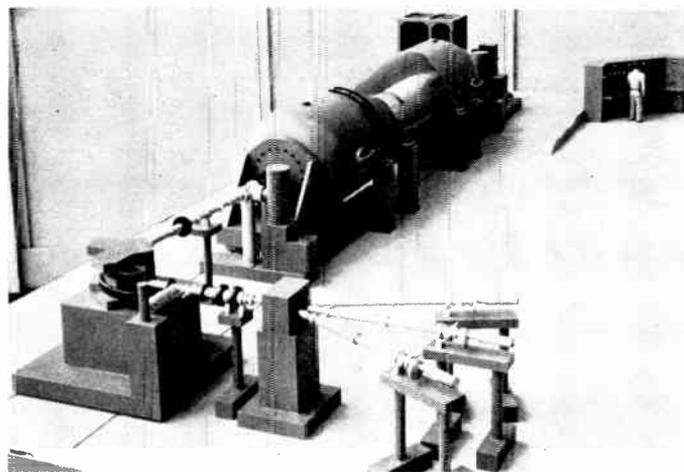
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PLANTS and PEOPLE



Canada Gets Accelerator

A 10-MEV TANDEM style Van de Graaff accelerator, now in final stages of assembly, promises to make possible an extended range of studies of nuclear-energy levels throughout the entire periodic table.

First unit (model pictured, with target end in foreground) being made by High Voltage Engineering Corp. of Burlington, Mass., will be delivered to Atomic Energy of Canada, Ltd., at Chalk River, Ontario. The Canadian agency ordered the \$1 million particle accelerator "off the drawing boards" in 1956. It is expected to be shipped in mid-1958 and will be ready early next year for nuclear-physics research.

Also under contract are two other units, one ordered by the U.S. Atomic Energy Commission for the University of Wisconsin; one for Florida State University, being paid for by the state.

"Florida is putting itself on the map in basic research," commented a physicist recently, as he pointed out that it is most unusual for a state government to authorize an outlay of \$1 million for a fundamental-research device.

The tandem-style positive ion accelerator increases by a factor of almost two, the useful energy range of the particle accelerator type pioneered by Robert J. Van de Graaff, chief physicist at High Volt-

age and associate professor of physics at Massachusetts Institute of Technology. Van de Graaff has spearheaded development of the machines which bear his name as far back as 1931.

Both the Russians and the British are working on tandem accelerators, but High Voltage executives believe theirs will be the first "off the production line." A start has already been made on components for the Wisconsin and Florida units. Meanwhile, High Voltage reports it has a half-dozen other orders "in prospect."



Washington U. Honors Honnell

A PLAQUE commemorating his recent designation as a fellow in the AIEE and the IRE was presented to Pierre M. Honnell (right), pro-

fessor of electrical engineering at Washington U., St. Louis, Mo., at a testimonial dinner given in his honor. The dinner was sponsored by the university's student chapters of the two institutes.

Making the presentation in the picture is Robert Koopman (left), head of the electrical engineering department at Washington U. and president of the St. Louis professional chapter of the AIEE.

The plaque was specially engraved to symbolize highlights in Homnell's research.



MPI Hires New R&D Engineer

CASCADE Research Division, Monogram Precision Industries, Inc., announces the appointment of Alfred J. Thompson (picture) as a research and development engineer. Before joining the Los Gatos, Calif., microwave component company, he was a senior electronics research physicist at Bitel-McCullough, Inc., having been with Eimac since 1952.

In his new post, Thompson will be working on traveling-wave tubes and backward-wave oscillators and will report directly to Ronald Soohoo, head of analytical research.

Marconi Shifts Two Engineers

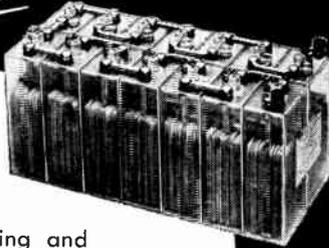
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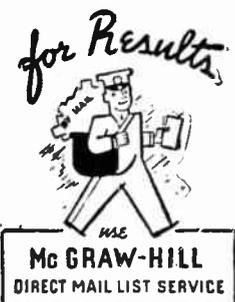
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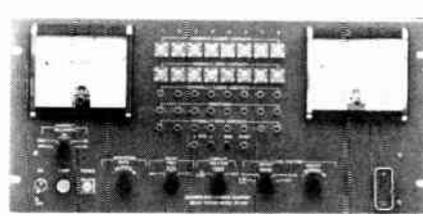
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coni's Wireless Telegraph Co. Ltd. has grouped the sections engaged in these activities into a single department to be known as Test Department.

H. J. H. Wassell, formerly chief radar engineer, is appointed manager of the new department. J. K. Todd becomes chief radar engineer.

Wassell joined the company in 1929. His work on transmitter development led to his appointment as chief of transmitter development group in 1945, and in 1949 he became head of radar development group. He has held the position of chief radar engineer since 1955.

Todd is with the firm since 1937. He has been chief of missile radar research group at the Marconi Research Laboratories since 1956.

News of Reps

B. B. Taylor Corp., manufacturer's rep for New York City and New Jersey, is named to carry the miniature pulse transformers of Pulse Engineering, Inc., Redwood City, Calif.

Vacuum Tube Products Co., Inc., Oceanside, Calif., appoints Houser Associates as sales reps for the southeastern states from Pennsylvania to Florida.

Bud Radio, Inc., Cleveland, Ohio, names R. G. Bowen Co. as representative in the Rocky Mountain area.

Wright Industrial Products will handle the Librascope, Inc. computer and controls component products in the states of Texas, Louisiana, Arkansas and Oklahoma.

Carl A. Stone Associates, Inc., will cover the states of California and Arizona in selling the products of RS Electronics Corp. of Palo Alto, Calif.

Radiation Counter Laboratories, Inc., Skokie, Ill., recently appointed Electromechanical Products of Agincourt, Ontario, to represent them in the Dominion of Canada.

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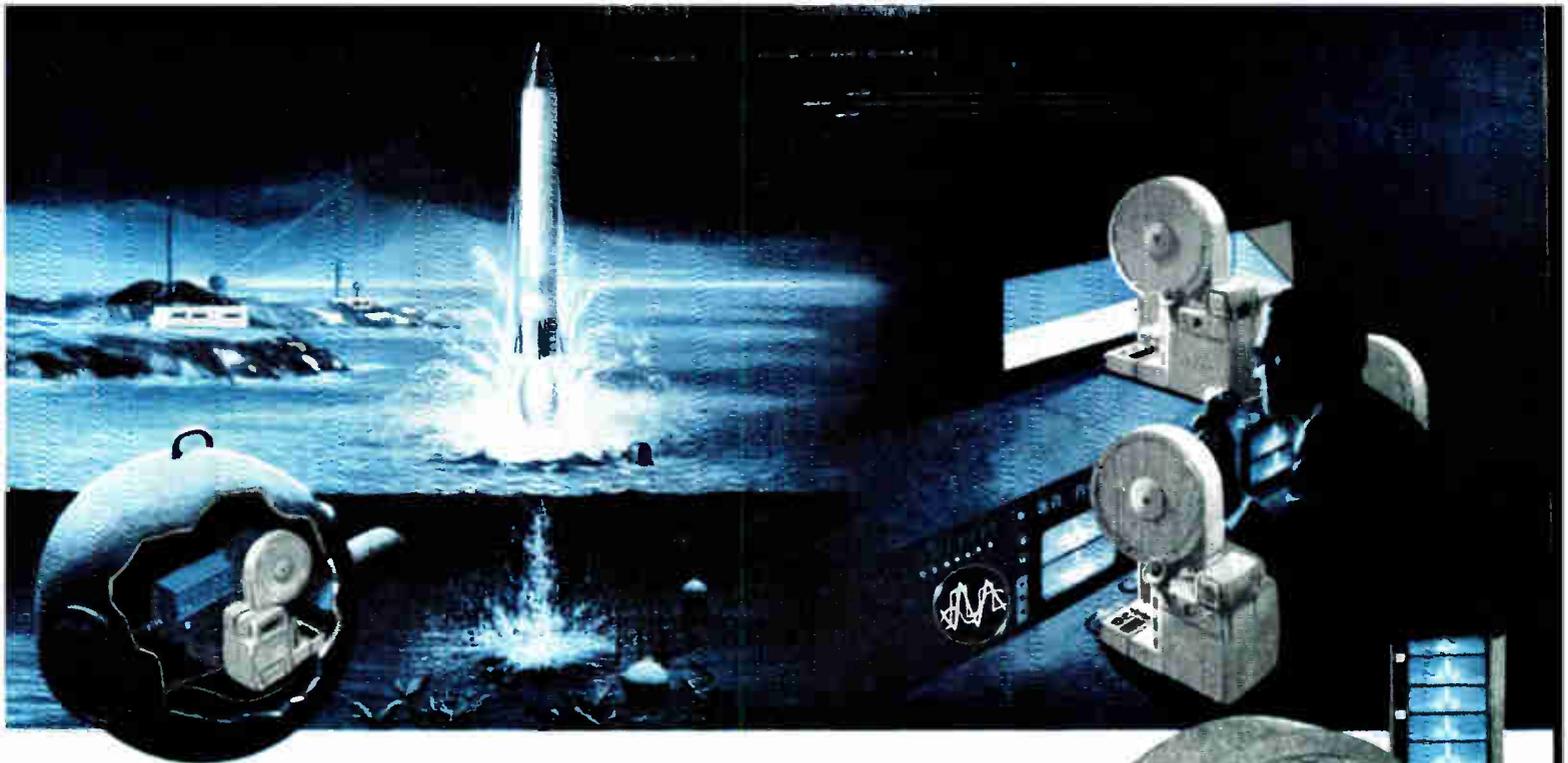
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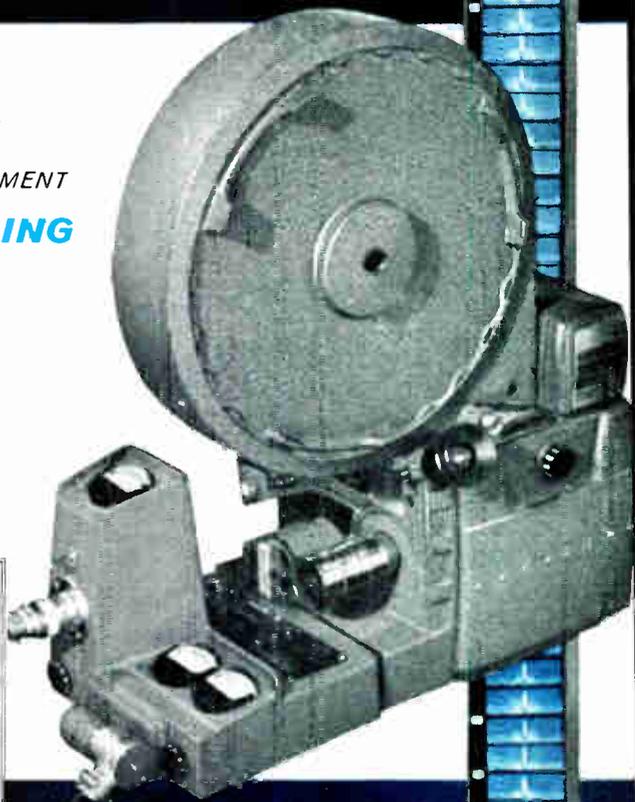
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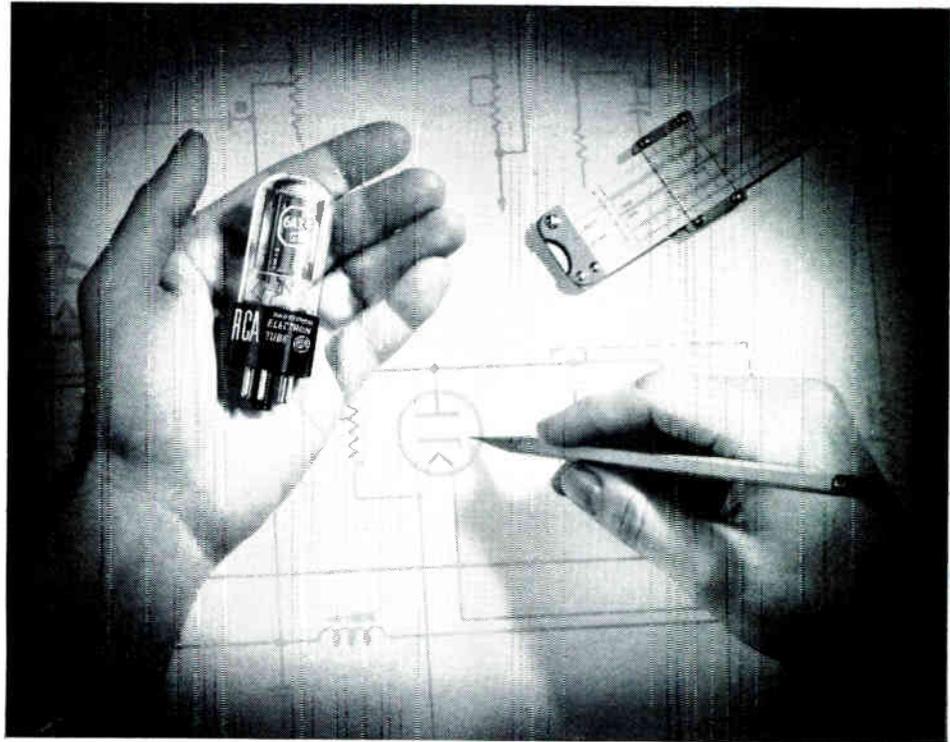
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