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(See page 31)

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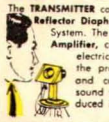

The **TRANSMITTER** consists of a **Light Source,** a **Modulating Reflector Diaphragm** and an Optical Projection System. The **RECEIVER** is a **Two-Stage Audio Amplifier,** controlled by a Photo-electric Cell that catches the projected light beam and causes the original sound waves to be reproduced in the loudspeaker.

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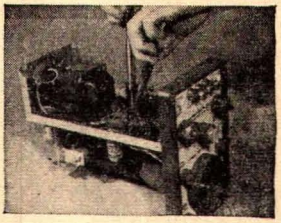

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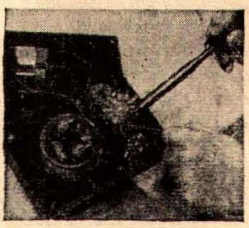

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• January/February 1970 • Vol. 9, No. 3

e/e elementary Electronics

Dedicated to America's Electronics Hobbyists

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Jan./Feb. 1970 Vol. 9/No. 3

Dedicated to America's Electronics Hobbyists

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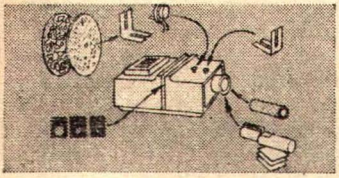

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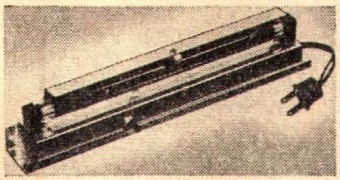

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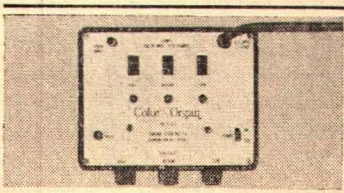

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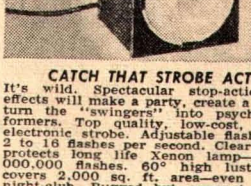

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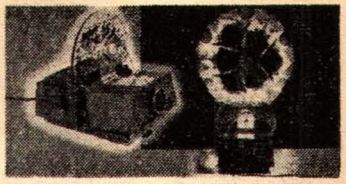

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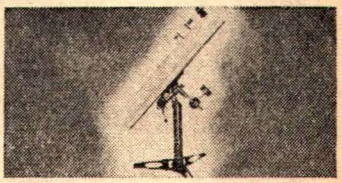

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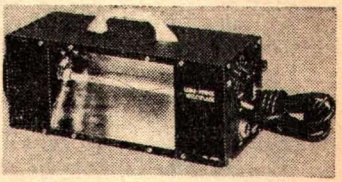

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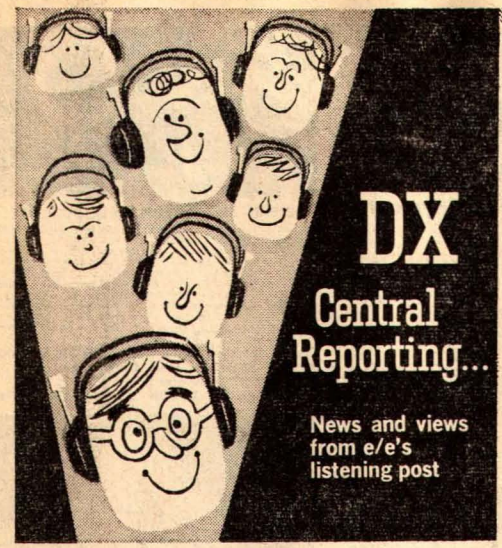
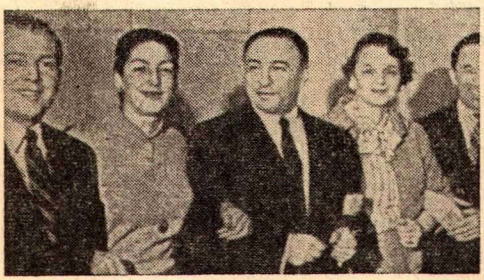


by Don Jensen

☐ Probably the slickest bit of flimflamery around today is an interesting little shortwave program known as Moscow Mailbag. The format of this weekly R. Moscow show is deceptively simple—informal, supposedly spontaneous answers to listeners' queries about life in the Soviet Union. But there is more to Moscow Mailbag than meets the ear!

Voice and brains behind the program belong to the dean of Russia's North American Service announcers, Joe Adamov. Since the stocky Slav joined the station's staff back in 1940, he has been more than just another radio voice. Adamov, it's said, is the real guiding spirit behind Moscow's English programming. He's credited with shaping up the broadcasts by dumping the old political harangues and Red Army Chorus records in favor of today's more listenable fare.

But in Moscow Mailbag silver-tongued Joe, the friendly answer man, has found the best showcase for his talents. He delights in fielding listeners' questions calculated to embarrass the U.S.S.R., presumably on the theory that the "hot" ones are most interesting to U.S. listeners. His skill is so great, his seemingly frank, common sense explanations so glib, that it's easy to miss the fact that he neatly skims over the sticky points.



Here's R. Moscow's staff for its North American Service in a pic snapped back in 1964. Chubby chap in center answers to name of Joe Adamov.

Adamov has studied stateside radio techniques. His delivery is informal, even colloquial, with plenty of "I-witness" personal references about himself. His accent is "standard American," no British intonations that make other shortwave services sound foreign to our ears. Joe's amiable, everyman style is disarming and is calculated to make his audience more receptive to his real pitch.

Moscow Mailbag *sounds* extemporaneous. But Adamov's replies are actually well prepared at least a week before the show. R. Moscow researchers and the Lenin Library staff help, but the final product is pure Adamov.

Even the sequence of questions is carefully planned. His female cohort leads off with noncontroversial inquiries about Russian culture, education, and the life of the typical man in the street. Halfway through the program, though, Adamov gets to the political and philosophical zingers!

On recent programs he has blasted the John Birch Society, argued that the U.S.S.R. doesn't promote revolutions abroad, outlined Moscow's position in the Sino-Soviet split, and gamely tried to explain away a flaw in basic Marxist-Leninist theory pointed out by one of Mailbag's many listeners.

Then the wrap-up questions on the 15-minute program are again lightweights, often giving Joe a chance to inject some humor to leave 'em chuckling.

Admittedly, the Mailbag's tag line—"You couldn't do better than write us that letter"—is a bit much. But if you want to hear a master propagandist at work, the show is interesting listening. It is aired six times each weekend on various transmitters used by Moscow's North American Service.

For SWLs living east of the Mississippi I suggest the transmission at 8:13 p.m. EST, Saturdays (0113 GMT, Sundays) on 15,150 kHz. (This broadcast, incidentally, comes from a R. Moscow transmitter at Minsk.) West Coasters should listen on 11,850 kHz at 10:13 p.m. PST (0213 GMT, Sundays).

Tip Topper. There's the American Forces Radio and Television Service. (Didja know the old "Armed Forces" designation has been dropped?) To boost the morale of their overseas garrisons, the British have their B.F.B.S. Russia, France, and Canada each have FM outlets for their troops in Germany. The Dutch, Thais, Koreans, Rhodesians have special forces programs for their soldiers. Fact is, it's getting so that any country with a regiment of troops or

a leaky gunboat has its own programs for its men in uniform.

From a DX standpoint, one of the better catches is R. Angkatan Udara, the voice of the Indonesian Air Force. For years it was a toughie in North America but last year a favorable schedule change changed that. R. Angkatan Udara now is heard on about 11,905 kHz around 1200-1230 GMT. Programming naturally, is in Indonesian but there are plenty of pop, though old, American records played.

The station, located in a Djakarta suburb, uses a 7.5-kW RCA transmitter and a simple three-wire dipole antenna. There's a second frequency, 2475 kHz, but its 500-watt transmitter is too weak for stateside reception. Logging reports should be sent to station manager Sofyan Alty, R. Angkatan Udara, 51 Djalan Tjipinang Tjempedak I, Djatinegara, Djakarta, Indonesia.

Unlike most forces broadcasters, R. Angkatan Udara has commercials, and for a very practical reason. Since the Indonesian Air Force is trying hard to become self sufficient, a toothpaste ad or two might just buy an extra gallon of aviation fuel.

Bandsweep. 1505 kHz—Remember the island of Anguilla, the mouse that roared back at the British lion? Now a Caribbean listener has heard what seems to be a local service British Forces Broadcasting Station on Anguilla until 0200 GMT one Sunday. **3315 kHz**—This month's Dawn Patrol Special is ORTF, Fort de France, Martinique which is heard signing on at 1000 GMT with *La Marseillaise*, the French national anthem. **4865 kHz**—Brunei Broadcasting Service at Berakas, Brunei, features Polynesian music after 1300 GMT. **5040 kHz**—The French speaker here, heard evenings, is R. Valparaiso, Port de Paix, Haiti, not R. Capois la Mort as has been widely reported. **5047 kHz**—The bird chirp interval signal heard on this frequency at 1329 GMT identifies R. Republik Indonesia's Djogjakarta station. It follows an Indonesian language program called Tempo-a-go-go. **9675 kHz**—A Peruvian with English programming? Try R. del Pacifico in Lima at 0200 GMT. **11,866 kHz**—The Voice of African Brotherhood, otherwise known as the Congo's R. Lubumbashi, is logged with English from 1900 to 2000 GMT. **15,135 kHz**—After moving around a bit, R. Iran seems to have settled its new, high-powered transmitter on this channel.

(Credits: Cesar Objio, Dominican Republic; Robert Sheperd, Australia; Stanley Cabrai, California; Gerry Dexter, Wisconsin; Del Hirst, Texas; F. J. Layman, Texas; Carter Scholz, N.J.; Sam Rowell, Washington; National Radio Club; Newark News Radio Club; North American SW Association.)

Odd Island. What solid chunk of land once was listed on the British Admiralty rolls as a naval vessel? Which island has a barren, lunar-

like landscape, but lies just south of the lush equatorial belt? Where do radio technicians sip duty-free Scotch, but carefully watch their consumption of water?

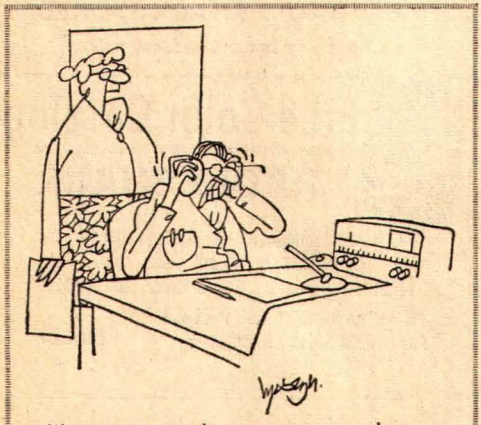
The answer to all three questions is Ascension Island, a tiny dot in the ocean midway between Brazil and tropical Africa. For the past few years it has been the location of the British Broadcasting Corporation's South Atlantic short-wave relay station.

Ascension's history is curious. Discovered by 16th Century Portuguese explorers, it was first occupied in 1815 by an English naval detachment sent to foil possible attempts to free the exiled Napoleon from St. Helena, 760 miles south. For some inexplicable reason, the British considered the island an honest-to-goodness man-of-war and christened it the HMS *Ascension.*

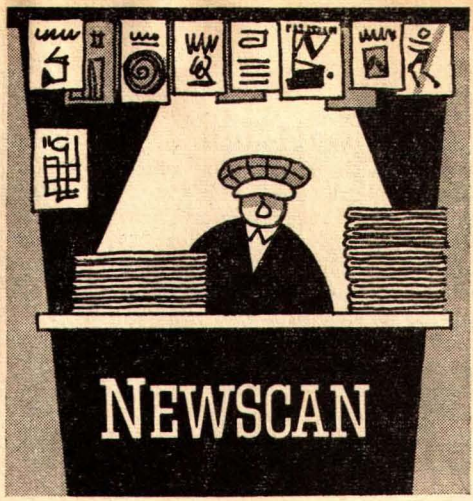
A cable station was established seventy years ago, but until an airstrip was blasted out of the rock during World War II, Ascension remained well off the beaten track. When the space era began, the U.S., under a lease arrangement, built a long-range missile tracking station.

In 1964, the BBC began building a major relay station. To house the high-powered transmitters, up went an L-shaped, concrete and glass structure, its architecture weirdly out of place amid the black, gray, and red volcanic rock and clinker outcroppings. But the island's location is ideal for rebroadcasting London's programs to Africa and the Western Hemisphere.

The station is run by a crew of nearly 30 Britishers and St. Helenians. There are attractive pre-fab homes, a shop, bachelors' mess, a dispensary, even a club with pool and tennis courts. There are no customs duties and the climate is healthy. Even the common cold is uncommon on Ascension. But obtaining fresh water is a bit of a problem. ■



"I put epoxy glue on your earphones. Now you won't miss anything!"

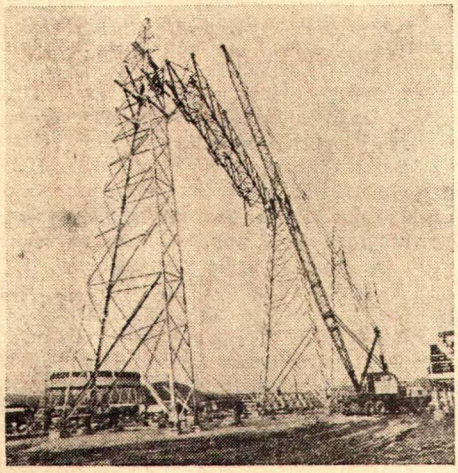


☆☆☆☆☆☆☆

Could Make a Lotta Beer Cans

A quarter of a million pounds of aluminum structures will be used in a new electric generating station designed to supply electricity to four states and the District of Columbia beginning in 1970. The station—presently under construction—is located at Huff, Pa., in a 1,750-acre site along the Conemaugh River.

Reynolds Metals Company is fabricating, subassembling and furnishing the substation structures which range from small stands supporting various switches and electrical gear to 110-foot electrical towers on which the 500,000-volt



A crossarm between two aluminum towers is lowered into place, in one phase of the construction of a substation structure for the Conemaugh electric generating station near Huff, Pa. A quarter of a million pounds of light-weight aluminum will be used in the generating station structures which is to supply electricity to four states and the District of Columbia beginning in 1970.

transmission lines will then be dead-ended.

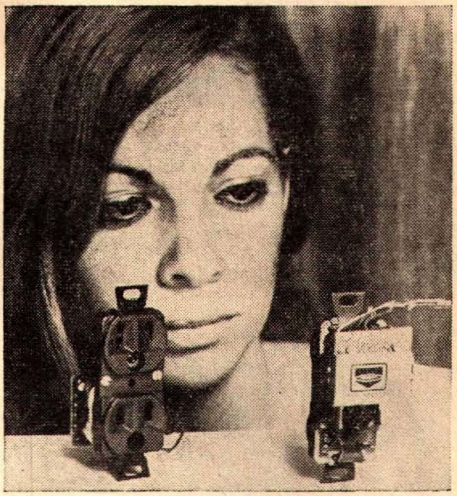
The aluminum structures used in the project will save long-term maintenance costs because they are corrosion resistant and do not require protective coatings or repainting. In addition, due to their light weight, they are relatively easy to erect.

Operated by the Pennsylvania Electric Company when complete, the generating station, consisting of two identical units, will have the capacity to light 18 million 100-watt light bulbs simultaneously—1.8 million kilowatts.

Build a Better Rat Trap

An electronic device no bigger than a grain of rice and concealed in an ordinary electrical outlet has been developed to "catch" burglars in a beam of invisible light. The tiny device and its concealing outlet form a new intrusion detection system is a miniature Texas Instruments TIXLO9 gallium arsenide light emitter. The system, with a range of 75 feet, has been developed for homes, offices and industrial or commercial areas. It can protect a single door or window, a row of windows, a corridor, a vault area, and similar locations.

The system creates a narrow band of infrared energy between a transmitter and a receiver, each located behind ordinary-looking wall sockets on opposite sides of the room or area. An intruder who breaks the beam triggers an alarm relay, setting off a warning device. An alarm connection unit remotely installed in



An electronic device no bigger than a grain of rice is concealed behind the lens in the electrical socket at left, ready to "catch" burglars in a beam of invisible light. A tiny, transistor-like Texas Instruments light emitter beams infra-red energy up to 75 feet to a receiver hidden in another outlet across a room or other area.

a closet or basement contains the circuitry that activates the alarm—which can be any standard bell, buzzer or siren.

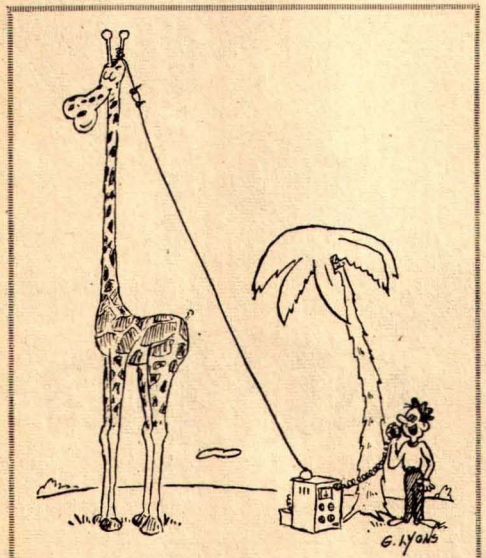
During operation, the TI semiconductor emitter transmits pulse-modulated light to the receiver. The receiver, a silicon photo diode equipped with an extremely sensitive narrow-band optical filter to reduce ambient light interference, "recognizes" the special frequency and accepts the light beam. The filter is not affected by varying intensities of other types of light, such as sunlight or interior lighting.

The receiver trips the alarm relay whenever it does not receive the proper amount of frequency of light.

If an intruder passes the wall outlets, thus breaking the infrared beam, the receiver does not register the modulated light and, therefore, triggers the alarm relay. Should a burglar attempt to deceive the detector by shining a flashlight with an infrared filter on the receiver, the absence of the special modulated beam would set off the alarm. *No cheating allowed, Charlie!*

Voltage is applied to the TI gallium arsenide diode to forward-bias its PN junction. As this occurs, it emits infrared energy in a narrow band around a 0.91 micron wavelength. Operating with a minimum power output of 500 uW, the TIXLO9 emitter is specially designed for optical communications over a distance.

Driven by a flat pack linear integrated circuit, the miniature-size diode—only 0.170-inch long and 0.100-inch wide—operates over a wide temperature range, consumes a substantially smaller amount of power than a light bulb, and will never wear out.



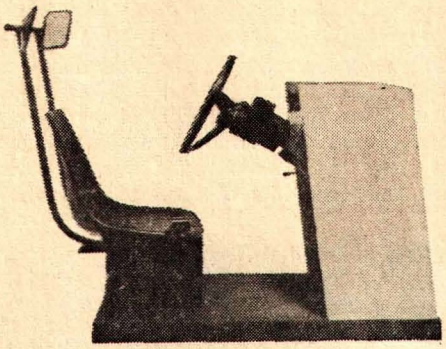
". . . and for an antenna, I'm using . . ."

The Mini-Sentry operates continuously for at least a year off a standard six-volt dry cell battery, unlike most detection systems which depend on 110-volt current. Constant power means that property remains under continual surveillance during extended local power failures or even deliberate interruption of power.

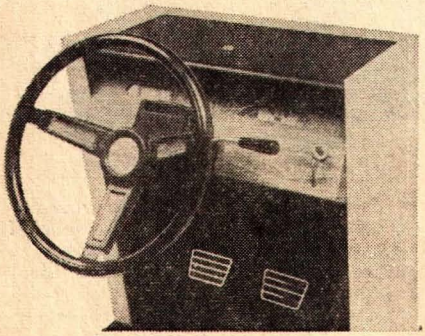
The complete Mini-Sentry system, consisting of the transmitter, receiver, alarm connection unit and a special adjustment tool, is priced at about $200. (Reader inquiries on the Mini-Sentry should be directed to Edwin Bruening, Laser Systems Corp., 313 North First Street, Ann Arbor, Michigan 48103.)

U-Drive-It

A new lower-priced driver instruction system produced by Raytheon Company permits a teacher to train 50 per cent more students than is possible with conventional dual control cars. A refinement of earlier models, the *Drivotrainer* Mark X is engineered to create an advanced system that both small and large schools can afford. Up to 25 students can be taught by one



Mark X Drivotrainer driving simulator (above) offers lower-priced driver instruction. Up to 25 single-seat, instrumented "cars" can be combined in a mobile or fixed classroom installation. Students drive in response to road and traffic conditions pictured in wide-screen color films. Photo below shows driver's controls and indicators.



instructor at the same time at a cost reduction of 30 per cent per pupil.

Developed by Raytheon Learning Systems Company of Michigan City, Indiana, in conjunction with Aetna Life & Casualty, Hartford, Connecticut, the Mark X will be used in the *Drivotrainer* simulator system in high schools and colleges in the United States and overseas.

The system is comprised of a simulated car with full operating controls, a 16mm motion picture projector, and a recorder to monitor and register student reaction to the *Drivavision* films used in the program.

A group of cars is assembled in a mobile or fixed classroom with a wide screen at the front of the class. Students "drive" in response to road and traffic conditions displayed on the screen. The color motion pictures, complete with sound tracks, were filmed through the windshield of a specially equipped camera car and show the road ahead from the driver's position, including views in the rear and side view mirrors. As they "drive," students are immediately aware of their right and wrong actions by appropriately paced narration on the film which asks: "Did you slow down for this intersection? . . . Did you cover your brake?," etc. A feed-back system also gives the student an instantaneous personal reminder.

The electronic cars contain all the basic controls and instruments found in new automobiles, whether they are furnished with automatic or manual transmission. Push buttons provide an easy and safe method of disengaging the electrical circuits of one transmission and engaging the circuits of the other. Printed circuitry with plug-in modules can easily be replaced if necessary by school personnel. Motor noise, clutch "friction point," and brake pedal "feel" add realism to the simulators.

The recorder, located at the back of the class, is electronically synchronized with the projector and will provide a printed record of any pre-selected individual driver action when set for automatic operation. An "instant reader" panel gives the instructor an immediate indication of each student driver's reaction to the driving situations as they appear on the screen. As many as 25 cars may be scored simultaneously by the recorder.

Sixteen *Drivavision* films depict a variety of driving conditions, including snow and fog, which allow the students to experience driving in adverse weather without risk. The films, prepared by driver education specialists of Aetna Life & Casualty, also include emergency situations for advanced students.

The *Drivotrainer* Mark X system, which in its simplicity adds a new dimension of reliability, requires a minimum of electrical installation and maintenance. (If you want more information, write to Raytheon Learning Systems Com-

pany, Route 12 East, Michigan City, Indiana 46360.

The Heat's On

A revolutionary breakthrough in the design of thermostats for residential and commercial heating and airconditioning has just been marketed by Kimco Laboratories, Inc. of Brooklyn, New York. The new thermostat, called *SpaceTemp* 100, is portable, wireless and electronic. It can be easily taken from room to room, controlling the temperature wherever it is located. Because it gives the exact temperature needed for any room, at any time, it has many of the advantages of a multi-zone system. What's more, it can turn an existing system into a simulated multi-zone system simply and inexpensively.

It works equally well with central heating, airconditioning, or combined systems; with gas, oil, electricity and even coal. Standard boilers, heat pumps, hot air and hydronic systems all can utilize the new *SpaceTemp* 100.

SpaceTemp 100 consists of two parts. First, a small portable electronic thermostat that is completely self-contained, and second, a responder unit, also small and lightweight, which is attached to the furnace or air-conditioner.

In operation, the *SpaceTemp* thermostat sends an electronic signal to the responder unit at the furnace, or air-conditioner, commanding it to produce the exact heat or cool air required. Then, it automatically monitors the temperature electronically to make sure it's on target.

Take the SpaceTemp 100 with you and the temperature you want follows you. It's exceptionally effective in helping to right faulty systems with uneven temperatures. Take it from the living room to the bedroom to the kitchen, wherever your activity is, and get the exact comfort you want when you want it.

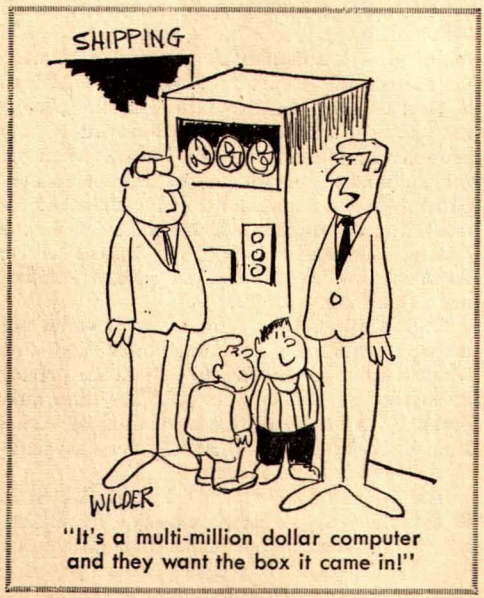
The *SpaceTemp* system is so simple, practically anyone can install it and have it operating in five minutes. The thermostat itself needs no installation, of course. As for the responder unit—it is fixed to the side of the heating or cooling unit, or simply attached to a wall. Two wires are attached to the relays of the burner or airconditioner and the unit plugged into an ordinary 110 Volt outlet. It's as simple as that.

Heating or air-conditioning systems that are causing problems because of uneven heat or cool air may often be updated and problems solved with *SpaceTemp* 100. A conventional thermostat stays on a wall, stuck there. It may control the temperature right at the wall, but a bedroom, playroom or garage at a distance from that wall can be freezing. *SpaceTemp,* on the other hand, is wireless and portable. It can be moved from room to room, guaranteeing accurate control of the temperature wherever it is located. It gives you the advantages of a zone system without the installation cost of a zone system. Moving a thermostat from one location to another is an expensive and troublesome project. Usually walls must be broken, new wiring installed and replastering and redecorating performed. But not with *SpaceTemp* 100. This electronic portable unit can be installed in a matter of minutes and the old thermostat simply ignored. Compared to actually moving a thermostat, the savings are considerable.

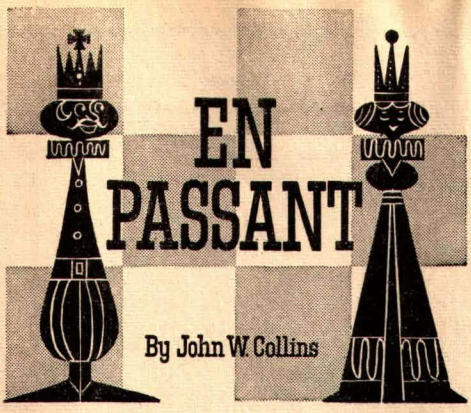
Peacetime Red Balling

An electronic central dispatch for the motor freight manager—which, at the flick of a switch,

(Continued on page 106)



"It's a multi-million dollar computer and they want the box it came in!"



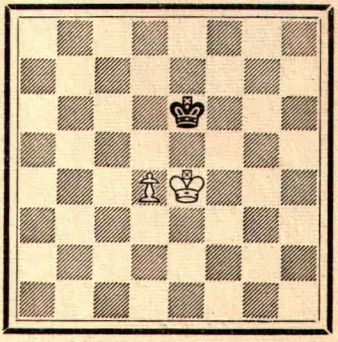
Now that we have looked at the elementary mates and some of the basic winning and drawing positions of the endgame in previous columns, we are ready to explore the various, main categories of that final third of the game —King and Pawn Endings, Knight and Pawn Endings, Bishop and Pawn Endings, Minor Piece Endings, Rook and Pawn Endings, Rooks and Minor Pieces Endings, and Queen Endings.

We start with the King and Pawn Endings, remembering that Philidor said: "The Pawn is the soul of chess." Soul *and* body. These delicate and difficult endings feature the role of the King and the queening of a Pawn. They require an understanding of opposition, triangulation, and winning a tempo. They require an understanding of pawn-formations, exchanges, and maneuvers, and of which pieces cooperate best with particular formations. Perhaps most important of all, these King and Pawn Endings, in fact all endings, provide a North Star for a player in the Middle-Game and even in the Opening.

First, an example of King and Pawn against King. This position is a draw for two reasons: The White King is behind (initially to the side) the Pawn and the Black King can reach the queening square (Q8) of the Pawn.

(Continued on next page)

Black



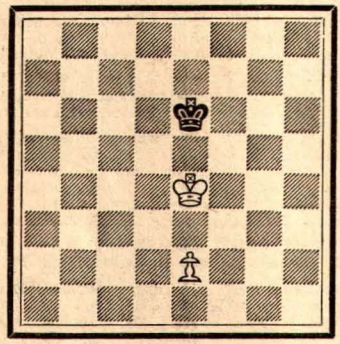
White

1 P-Q5#	K-Q3	5 K-Q5	K-Q1!	
2 K-Q4	K-Q2	6 K-K6	K-K1	
3 K-K5	K-K2	7 P-Q7#	K-Q1	
4 P-Q6#	K-Q2	8 K-Q6	stalemate	

A stalemate is a draw. It occurs when the player on the move has no legal move, but is not in check. It is instructive that in the foregoing if Black had played 5 . . . K-K1? (instead of following the rule of going straight back with the text 5 . . . K-Q1!) White would have won with 6 K-K6, K-Q1 7 P-Q7, K-B2 8 K-K7 followed by 9 P-Q8=Q(#).

In the second example, White's King is in front of the Pawn and the first player wins with or without the move.

Black



White

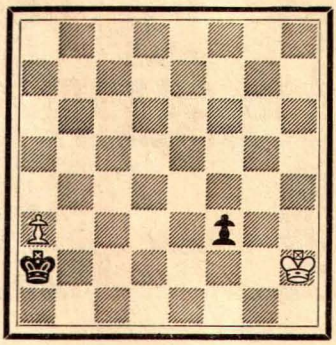
1 P-K3!	K-Q3	5 P-K5	K-K1
2 K-B5	K-Q2	6 K-K6!	K-Q1
3 K-B6	K-Q1	7 K-B7	. . . .
4 P-K4	K-Q2		

And White queens and wins. With Black to move, the winning line is 1 . . . K-Q3 2 K-B5, K-K2 3 K-K5, K-Q2 4 K-B6, K-K1 5 K-K6, K-Q1, 6 P-K4, K-K1 7 P-K5, K-Q1 8 K-B7 and the Pawn goes marching in.

And third, King and Pawn against King and Pawn. This is a composition by H. Rinck, 1922. With Black threatening White's passed Pawn, and having his own well-advanced passer, this is more difficult than it looks. But White just manages to win because he is on the move and his King can reach the queening square of the enemy Pawn (diagram at top of page).

Black's Pawn is blockaded. White's is in the clear, queens, provides the winning material advantage. White also beats 2 . . . K-B5 (instead) of 2 . . . K-B6) with 3 P-R6, K-Q6 4 P-R7, P-B7 5 P-R8=Q, P-B8=Q 6 Q-R6# K any 7 QxQ.

Black

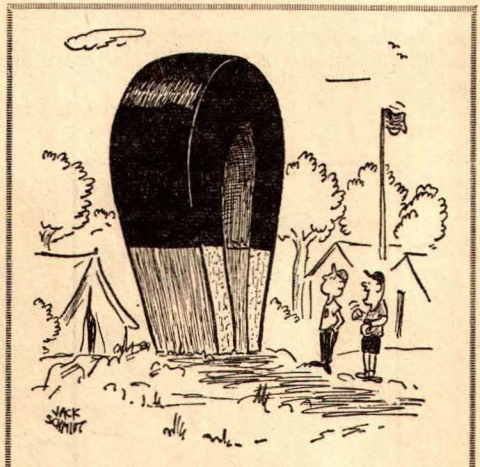


White

1 P-R4	K-N6	4 P-R6	K-K6
2 P-R5	K-B6	5 K-B1!	. . . .
3 K-N1!!	K-Q5		

Game of the Issue. Frank James Marshall, 1877-1944, was Chess Champion of the United States for twenty-seven years. He won the title by decisively defeating Jackson W. Showalter in a match in 1909 and held it until he voluntarily retired in 1936. He was born in New York, moved to Montreal with his family at the age of eight, and resided there for eleven years. At the age of ten, his father, a fairly good player, taught him to play chess.

Marshall began climbing the ladder almost immediately. Within a year, he was able to successfully spot his father a Rook. He soon began playing at the Hope Coffee House and then joined the Montreal Chess Club and became its champion in 1894. Two years later, his family returned to New York and he soon became one of the top players in the metropoli-



"Your compass always points back to camp!"

tan area. In 1899, he captured the championship of the famous Brooklyn Chess Club and was ready for the international arena.

A long, full career, at home and abroad, replete with many successes and failures, began for Marshall in 1899. In that year, the Brooklyn and Manhattan Chess Clubs sent him to compete in the London International Tournament. Expecting to be in the Masters section of the event, he found to his disappointment he had been entered in the minor half of it. Deciding to play anyway, he went all out and won it with a score of 8½-2½. Among the numerous tournaments which were to follow, he racked up firsts at Monte Carlo, 1904, Cambridge Springs, 1904 (his greatest triumph), St. Louis, 1904, Scheveningen, 1905, Barmen, 1905, Nuremberg, 1906, Dusseldorf, 1908, New York, 1911, Budapest, 1912, Havana, 1913, Hopatcong, 1924, Chicago, 1926, and several Marshall Chess Club Championships. There were many important seconds, thirds, and fourths too, among them Paris, 1900, 3rd and 4th, Ostend, 1907, 3rd and 4th, New York, 1913, 2nd, St. Petersburg, 1914, 4th and 5th, and New York, 1924, 4th. All this was supplemented with matches, International Team Tournaments, and Metropolitan Chess League Matches. A lifetime of chess!

In 1931, the Marshall Chess Club was established at 23 West 10th Street, New York, N.Y. It is still there today, a lasting monument to an American Champion.

Marshall's style of play made him a great favorite with spectators. It was an attacking style, abundant with combinations, traps, and "swindles," providing open positions, designed

"Put down the phone—back to work . . Beep . . put down the phone—back to work . . Beep . ."

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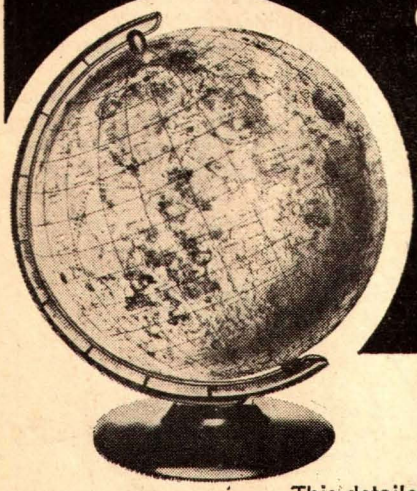

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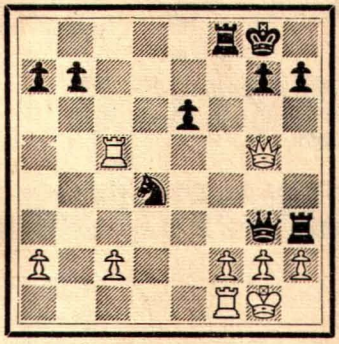
for a quick knockout. Although he achieved many brilliancies with it, too often he found it did not work against solid, defensive, positional masters. As time went on he modified it, adopting a more balanced style.

The following game is one of Marshall's most famous. The story goes that when it ended the spectators 'showered him with gold pieces!' He had Black and his opponent was S. Lewitzky. It was a French Defense and was played at Breslau, 1912.

1	P-Q4	P-K3	13	B-R3	QR-K1
2	P-K4	P-Q4	14	Q-Q2?	B-N5!
3	N-QB3	P-QB4	15	BxN	RxB
4	N-B3	N-QB3	16	QR-Q1	Q-B4
5	KPxP	KPxP	17	Q-K2?	BxN
6	B-K2	N-B3	18	PxB	QxP
7	0-0	B-K2	19	RxP	N-Q5
8	B-KN5?	0-0	20	Q-R5	QR-KB1!
9	PxP	B-K3	21	R-K5	R-R3
10	N-Q4	BxP	22	Q-N5	RxB
11	NxB?	PxN	23	R-QB5	Q-KN6! !
12	B-N4	Q-Q3		Resigns	

Position after 23 . . . Q-KN6



Why did White resign? Because he will be mated or will lose a piece. Here is the analysis—

A. If 24 Q-K5 (24 K-R1, QxRP mate), N-K7# 25 QxN, QxRP mate.

B. If 24 QxQ, N-K7# 25 K-R1, NxQ# 26 K-N1 (26 BPxN, RxR mate), NxR 27 PxR, N-Q7 and Black wins with his extra Knight.

C. If 24 R-Q1, QxRP# 25 K-B1, Q-R8 mate.

D. If 24 BPxQ, N-K7# 25 K-R1, RxR mate.

E. If 24 RPxQ, N-K7 mate.

Marshall said 23 . . . Q-KN6 was the most elegant move he had ever played!

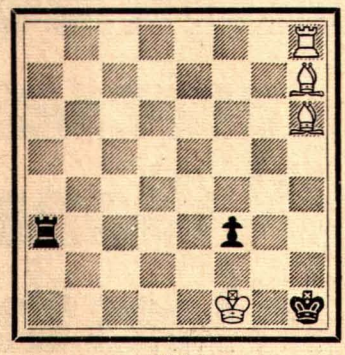
Solution to Problem 21: 1 R-QR8.

If 1 . . . KxR 2 Q-B3 mate. If 1 . . . K-N3 or K-B3 2 Q-N5 mate. And if 1 . . . B-N3 (on any other Bishop move 2 Q-R6 mates) 2 Q-B3 mate.

Problem 22

By M. Lipton
Jerusalem Post, 1960

Black



White

White to move and mate in two.
Solution in next issue.

News and Views. Grandmaster Pal Benko of New York once again won the U.S. Open at Lincoln, Neb., with a 9½-2½ total. What else is new?

For an unprecedented ninth time, Mrs. Gisela K. Gresser of New York won the 1969 U.S. Women's Championship with a 7½-1½ score, a full point ahead of the field.

Kenneth Rogoff of Rochester, N.Y., a popular rising star, compiled 6-1 to win the 1969 U.S. Junior Championship. At sixteen, he is the youngest player ever to win the annual event.

The 1969 U.S. Amateur Championship was held at Philadelphia, Pa., and Kimbal Nedved took it with a clean sweep of 6-0.

Nona Gaprindashvili, 28, Republic of Georgia, USSR, is the Queen of Chess. She defeated A. Kushnir by 8½-4½ to win the Women's World Championship for the second time in a row. ■

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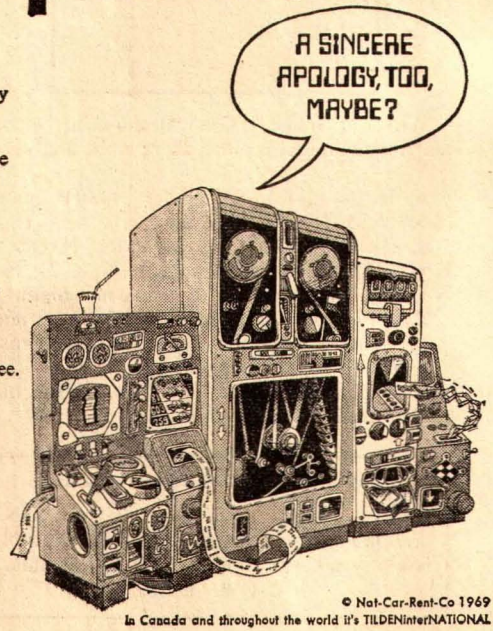
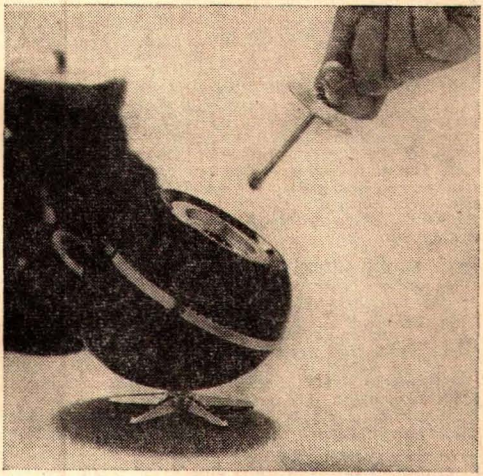


A Regular Ball o' Fire

Want to make your boss happy for Christmas? Here's a new, different kind of table lighter, operated by battery. It's called ElectroMatch and it's available in black or white with gold trim. The "match" is a life-time nylon wick encased in metal with a sculptured handle. There is no flint to replace; a

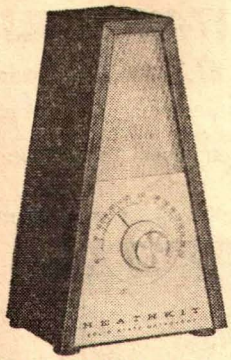


Korex ElectroMatch Table Lighter

large fluid reservoir lasts for weeks, and batteries last for 6 months. Price is $19.95 with a one-year guarantee. Write to Korex Industries, 821 Malcolm Rd., Burlingame, Calif. 94010.

Keeping Time with Solid State

Here's a solid-state metronome kit, the TD-17, from the Heath Company. It's adjustable from 40 to 210 beats per minute. You set the desired tempo on a large, easy-to-read dial and the volume is adjustable by a control on the back panel. There's a chart on the bottom that converts tempo in different time signatures to beats per minute. The TD-17 uses batteries and maintains its accuracy indefinitely. Unit assembles in about two hours on one small circuit board and is furnished with a cherry-finished cabinet. Price is a mere $12.95. Write for more information to the Heath Co., Benton Harbor, Mich. 49022.

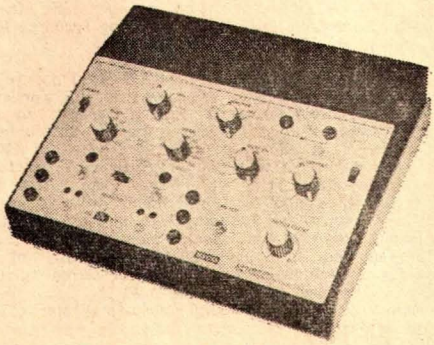


Heathkit TD-17 Metronome

Hardtop Convertible

With the new EICO Model 443 you can convert your scope to a curve tracer. This transistor-diode curve tracer makes it possible for you to obtain direct readout of semiconductor characteristics on an oscilloscope. Diode and rectifier curves then can be traced include forward voltage, forward current, reverse current, and peak inverse voltage. Transistor tests include h_{FE}, h_{OE}, i_{CEO}, v_{CE}, (sat), and bv_{CBO}. Beta can be read

(*Continued on Page 105*)



EICO Transistor-Diode Curve Tracer

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Here are six interesting "do-it-yourself" projects chosen for you by the editors of CAR REPAIR. Each has been selected because of utility value, outstanding design and ease of construction. Pick your favorite and begin your at-home project today. Use the convenient coupon below.

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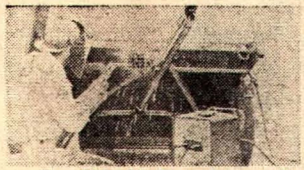
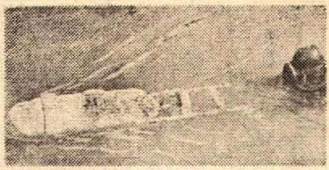
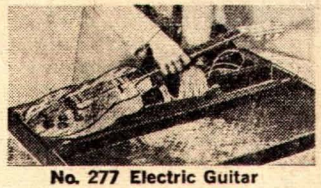


No. 246. AC Transformer Arc Welder



No. 320 Scuba Scooter

No. 326 Beats Walkin'



No. 277 Electric Guitar

No. 293 Micro-Midget Racer

331. MARINE CONVERTED AUTO ENGINE. A salvaged auto engine and some do-it-yourself technique add up to the least-expensive way of getting inboard power for your own runabout, cruiser or houseboat. If you've shied away from building or owning an inboard powered boat because of the high cost of marine engines, you'll find that compact auto engines converted to marine use were meant for you. Also, their simplicity, as compared to larger and older engines, and their high horsepower-to-weight ratings make them a first choice among performance-minded do-it-yourself boat builders. The cost of converting the Champion engine came to $185, including $75 for the basic engine and $10 for the transmission, representing a savings of over $1,000 on a comparable marine engine.

326. BEATS WALKIN'. This tote-all scooter can be made with an old bike frame and a used one-lung engine. Add a little expert scrounging and with less than $40 you can build one of these mile shrinkers for you and the kids to zip around on. For weekend hunting or camping, you can carry it in your car trunk as far as your car can go, then unload and take off! You can make this high-power, high-ratio sports version for off-the-road use, or with high power and low ratio, but without the load rack, and you have a fast street job. For street operation it has pneumatic tired wheels and a top speed of about 26 mph with a 2½ or 3 hp 4 cycle engine. The child's model with semi-pneumatic tires and a 10/5 to 1 drive ratio, will have a top speed of 10 to 12 mph using a 1½ to 2 hp engine.

246. AC TRANSFORMER ARC WELDER. Once you have used an arc welder in your shop you will wonder how you got along without it. For making new things of metal or repairing old things it has no substitute. This welder is an AC transformer type rated at 150 amps when connected to a 220/240V, 60 cycle, single-phase circuit. Maximum output when operated wide open is 180 amps at 60V. It will handle welding electrodes (rods) up to and including 3/16 in. dia., which is large enough to weld steel several inches thick by the multipass method. By rearranging two connecting links, the welder can be used on 110/120V house current fused at 30 amps for use with 1/16 and 3/32 in. electrodes. Because of the hand-wheel controlled, movable core-shunt transformer design, the welding-current setting can be regulated to a fraction of an ampere throughout the full welding range.

277. ELECTRIC GUITAR. Not only are electric guitars more versatile than non-electric, they are far easier to play. Reason why? Because far less finger pressure is required and, thus, chord and melody changes can be made much more quickly and efficiently. One excellent commercial model electric costs around $135 new; professional musicians spend up to and over $500 for their electrics—with this plan you can build an electric guitar, with case, for only $40-$45 for materials. Full instructions.

320. SCUBA SCOOTER. Water is 800 times as dense as air—this you realize as you kick your way through it in your diving outfit, using up your air supply in the effort of swimming. All this hard work is done for you by the Scuba Scooter which you can build for $175 or less. The unit can be weighted for ¾ or 1 pound positive buoyancy underwater, so that if let go, it will slowly rise to the surface. Control is automatic; if you grasp the handle at the switch, the motor turns; if you release it, the motor stops.

293. MICRO-MIDGET RACE CAR. Designed to meet all requirements for competition track racing sanctioned by the National Micro Midget Association, this little racer (which will hit about 55 mph. on the straightaway) is the end result of nine years of experience in building and racing micro midgets by Wayne Ison, winner of 48 feature races and two championships. The cost of materials for this car is about $400 in all, including a new engine. The same car, if you were to have it built commercially, would cost from $800 to $1000. Three sheets of plans explain all details of construction.

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ELEMENTARY ELECTRONICS ETYMOLOGY

By Webb Garrison

Potassium

▲ The substance we now call potash, obtained in impure form by leaching wood ashes, was familiar to the ancients. Arabs introduced it to Romans, and from the Arabic name for it a Latin title, *kalium,* came into vogue.

Until modern times kalium was considered to be an element. Lavoisier (1743-1794) insisted that it is a compound but was unable to separate it into its components. That job was accomplished by Sir Humphry Davy in 1807.

Davy decomposed caustic potash by means of electrolysis. In the process he discovered that one constituent is a metallic element—the first element to be isolated by means of an electric current.

From the common English name for the parent compound, *potassium* came to name the new substance. Scholars clung to Latin, though. So the symbol for potassium is K rather than P.

Metallic potassium proved too reactive to have any important uses until it was found ideal for certain kinds of fire bombs. For decades it was employed chiefly as a component of fertilizers and as a raw material in manufacture of soap and glass.

This alkali metal with photosensitive characteristics is now used on cathodes of photo-tubes when maximum response to blue light is desired. Crystals of potassium dihydrogen phosphate have piezoelectric properties important in functioning of sonar transducers.

In addition, the highly reactive metal found in ashes from the pot plays a major role within your body. A person without enough potassium lacks capacity properly to transmit electrical impulses in nerves plus heart and other muscles. Dr. Dan Snively, internationally known specialist in body fluids, holds that were it not for the special electro-chemical properties of potassium, life as we know it could not exist.

Doppler Effect

▲ German-born mathematician Christian Doppler lived and died in obscurity. Early in the 1840s, with the advent of the railroad, he became interested in a queer phenomenon. To a listener by a track, the pitch of an approaching whistle becomes higher. But as a whistle moves away, its pitch changes in opposite fashion and becomes lower.

Sound waves from an approaching source must be "shortened," reasoned the scientist. Those from a receding source must somehow be "stretched." No one else had ever bothered to investigate this matter, so it was natural that the phenomenon should be called the *Doppler effect.*

Soon after the name came into vogue astronomers found that light also exhibits the Doppler effect. Here, there is a change in color comparable to the change of pitch earlier noticed in sound waves.

Light waves from a source moving away from an observer tend to be shifted down the spectrum toward the red end. Such a "red shift" indicates that a celestial body is receding. A "blue shift" means that it is approaching.

It's now thought that all electromagnetic radiation exhibits the Doppler effect. While experimental proof concerning its universality isn't yet available, the concept has been put to work. Radar distinguishes between stationary and moving targets, measures velocity of targets ranging from cars on interstate highways to jet fighters over Viet Nam by means of the frequency shift between emitted and reflected radiation.

Tachyon

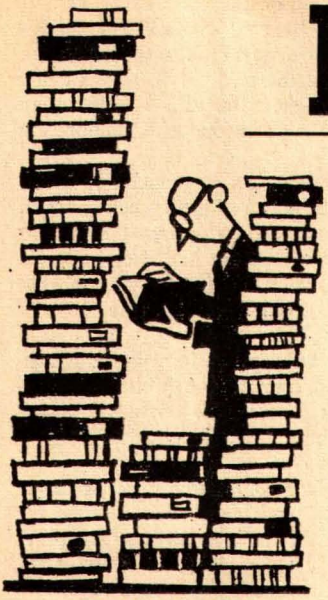
▲ Only a few recently published scientific works include the term *tachyon*—coined a few years ago from Greek for "swift." Yet scientists at Princeton, Indiana State University, and several major European centers are feverishly hunting the tracks of tachyons.

Why search for something that has been named but has never been seen?

Many revolutionary discoveries have come as a result of testing theoretical ideas. When Einstein announced his General Theory of Relativity, laboratory proof supporting some of its chief emphases was lacking. But it was Einstein's theory that propelled us into the atomic age.

Columbia University physicist Gerald Feinberg questions Einstein's conviction that the speed of light is ultimate. On the other side of the speed-of-light barrier, says he, there may be strange particles that can never travel as slowly as light. To him, "tachyon" seemed just right as a label for a hypothetical super-swift particle, and the name has been adopted by physicists everywhere. ■

LITERATURE



ELECTRONIC PARTS

★**2.** Now, get the all-new 512-page, fully illustrated *Lafayette Radio* 1969 catalog. Discover the latest in CB gear, test equipment, ham gear, tools, books, hi-fi components and gifts. Do it now!

★**5.** *Edmund Scientific's* new catalog contains over 4000 products that embrace many interests and fields. It's a 148-page buyers' guide for Science Fair fans.

4. *Olson's* catalog is a multi-colored newspaper that's packed with more bargains than a phone book has names. Don't believe us? Get a copy.

1. *Allied's* catalog is so widely used as a reference book that it's regarded as a standard by people in the electronics industry. Don't *you* have the 1969 *Allied Radio* catalog? The surprising thing is that it's free!

7. Before you build from scratch, check the *Fair Radio Sales* latest catalog for electronic gear that can be modified to your needs. *Fair* way to save cash.

8. Get it now! *John Meshna, Jr.'s* new 96-page catalog is jam packed with surplus buys—surplus radios, new parts, computer parts, etc.

140. How cheap is cheap? Well, take a gander at *Cornell Electronics'* latest catalog. It's packed with bargains like 6W4, 12AX7, 5U4, etc., tubes for only 33¢. You've got to see this one to believe it!

135. *RCA* Experimenter's Kits for hobbyists, hams, technicians and students are the answer for successful and enjoyable building, creating, experimenting and learning. Find out for yourself by circling 135 now!

106. With 70 million TV and 240 million radios somebody somewhere will need a vacuum tube replacement at the rate of one a second! Get *Universal Tube Co.'s* Troubleshooting Chart and facts on their $1.50 flat rate per tube.

10. *Burstein-Applebee* offers a new giant catalog containing 100s of big pages crammed with savings including hundreds of bargains on hi-fi kits, power tools, tubes, and parts.

11. Now available from *EDI (Electronic Distributors, Inc.):* a catalog containing hundreds of electronic items. *EDI* will be happy to place you on their mailing list.

6. Bargains galore, that's what's in store! *Poly-Paks Co.* will send you their latest 8-page flyer chock-full of *Poly-Paks'* new $1.00 electronic and scientific "blis-dor" paks and equipment.

★**23.** No electronics bargain hunter should be caught without the 1969 copy of *Radio Shack's* catalog. Some equipment and kit offers are so low, they look like misprints. Buying is believing.

CB—AMATEUR RADIO SHORTWAVE RADIO

102. No never mind what brand your CB set is. *Sentry* has the crystal you need. Same goes for ham rigs. Seeing is believing, so get *Sentry's* catalog today. Circle 102.

146. It may be the *first*—*Gilfer's* speciality catalog catering to the SWL. Books, rigs, what-nots—everything you need for your listening post. Go *Gilfer*, circle 146!

100. You can get increased CB range and clarity using the "Cobra-23" transceiver with speech compressor—receiver sensitivity is excellent. Catalog sheet will be mailed by *B&K Division of Dynascan Corporation.*

141. Newly-designed CB antenna catalog by *Antenna Specialists* has been sectionalized to facilitate the picking of an antenna or accessory from a handy index system. Man, *Antenna Specialists* makes the pickin' easy.

130. Bone up on the CB with the latest *Sams* books. Titles range from "ABC's of CB Radio" to "99 Ways to Improve your CB Radio." So Circle 130 and get the facts from *Sams.*

107. Want a deluxe CB base station? Then get the specs on *Tram's* all new Titan II—it's the SSB/AM rig you've been waiting for!

96. Get your copy of *E. F. Johnson's* new booklet, "Can *Johnson* 2-Way Radio Help Me?" Aimed for business use, the booklet is useful to everyone.

129. Boy, oh boy—if you want to read about a flock of CB winners, get your hands on *Lafayette's* new 1969 catalog. *Lafayette* has CB sets for all pocketbooks.

46. Pick up *Hallicrafters'* new four-page illustrated brochure describing Hallicrafters' line of monitor receivers —police, fire, ambulance, emergency, weather, business radio, all yours at the flip of a dial.

116. Pep-up your CB rig's performance with *Turner's* M+2 mobile microphone. Get complete spec sheets and data on other *Turner* mikes.

48. *Hy-Gain's* new CB antenna catalog is packed full of useful information and product data that every CBer should know. Get a copy.

111. Get the scoop on *Versa-Tronics'* Versa-Tenna with instant magnetic mounting. Antenna models available for CBers, hams and mobile units from 27 MHz to 1000 MHz.

45. CBers, Hams, SWLs—get your copy of *World Radio Labs'* 1969 catalog. If you're a wireless nut or experimenter, you'll take to this catalog.

101. If it's a CB product, chances are *International Crystal* has it listed in their colorful catalog. Whether kit or wired, accessory or test gear, this CB-oriented company can be relied on to fill the bill.

103. *Squires-Sanders* would like you to know about their CB transceivers, the "23'er" and the new "S5S." Also, CB accessories that add versatility to their 5-watters.

TOOLS

★**78.** Want to speed setting of locknut/screw controls? *Xcelite's* new HSC-1 interchangeable hollow-shaft nutdriver with drilled handle lets you adjust nut and screw simultaneously. *Xcelite* will send Bulletin N867 on request.

118. Secure coax cables, speaker wires, phone wires, etc., with *Arrow* staple gun tackers. 3 models for wires and cables from 3/16" to 1/2" dia. Get fact-full Arrow literature.

ELECTRONIC PRODUCTS

143. Bring new life to your hobby. Exciting plans for new projects—let *Electronics Hobby Shop* give you the dope. Circle 143, now.

★**44.** Kit builder? Like wired products? *EICO's* 1969 catalog takes care of both breeds of buyers. 32 pages full of hi-fi, test, CB, ham, SWL, automotive and hobby kits and products —do you have a copy?

★**42.** *Heath's* new 1970 full-color catalog is a shopper's dream. Its 116 pages are chuck full of gadgets and goodies everyone would want to own. Mostly kits are shown but many factory-wired products are available. Get your catalog today!

144. Hear today the organ with the "Sound-of-Tomorrow," the Melo-Sonic by *Whippany Electronics.* It's portable—take it anywhere. Send for pics and descriptive literature.

12. *C. B. Hanson* new Automatic Control records both sides of a telephone call automatically—turns off automatically, too! Get all the details —today!

126. Did you dig *Delta's* new literature package chucked full of pics and

LIBRARY

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specs on such goodies as an FET-VOM, SCR ignition system, computerized auto tach, hi-voltage analyzer, etc.? Man, then let *Delta* know you're alive! Circle 126 now!

109. *Seco* offers a line of specialized and standard test equipment that's ideal for the home experimenter and pro. Get specs and prices today.

9. Troubleshooting without test gear? Get with it—let *Accurate Instrument* clue you in on some great buys. Why do without?

145. *Alco Electronic Products* has 28 circuit ideas using their remote control relay. Get 100-and-one odd jobs done at home without calling an electrician. Get all the facts today!

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★136. You can become an electrical engineer *only* if you take the first step. Circle 136 and *ICS* will send you their free illustrated catalog describing 17 special programs. *ICS* also has practical electrical courses that'll increase your income.

★74. Get two free books—"How to Get a Commercial FCC License" and "How to Succeed in Electronics"—from *Cleveland Institute of Electronics*. Begin your future today!

★3. Get all the facts on *Progressive Edu-Kits* Home Radio Course. Build 20 radios and electronic circuits; parts, tools and instructions come with course.

142. *Radio-Television Training of America* prepares you for a career—not a job. 16 big kits help you learn as you build. 120 lessons. Get all the facts today!

114. Prepare for tomorrow by studying at home with *Technical Training International*. Get the facts today on how you can step up in your present job.

★137. For success in communications, broadcasting and electronics get your First Class FCC license and *Grantham School of Electronics* will show you how. Interesting booklets are yours for the asking.

HI-FI/AUDIO

26. Get with today's hi-fi jet set. *H. H. Scott* sets the pace with their fantastic line of audio components, some in kit form, too! *Scott* will send you all the poop if you circle 26!

104. You can't hear FM stereo unless your FM antenna can pull 'em in. Learn more and discover what's available from *Finco's* 6-pages "Third Dimensional Sound."

119. *Kenwood* puts it right on the line. The all-new *Kenwood* FM-stereo receivers are described in a colorful booklet complete with easy-to-read-and-compare spec data. Get your copy today!

30. *Shure's* business is hi-fi — cartridges, tone arms, and headphone amps. Make it your business to know *Shure!*

17. Mikes, speakers, amps, receivers—you name it, *Electro-Voice* makes it and makes it good. Get the straight poop from *E-V* today.

99. Get the inside info on why *Koss/Acoustech's* solid-state amplifiers are the rage of the experts. Colorful brochure answers all your questions.

TAPE RECORDERS AND TAPE

14. You just gotta get *Craig's* new pocket-size, full-color folder illustrating what's new in home tape recorders—reel-to-reel, cartridge and cassette, you name it! It looks like a who's who for the tape industry.

123. Yours for the asking—*Elpa's* new "The Tape Recording Omnibook." 16 jam-packed pages on facts and tips you should know about before you buy a tape recorder.

31. All the facts about *Concord Electronics Corp.* tape recorders are yours for the asking in their free 1970 catalog. Portable, battery operated to four-track, fully transistorized stereos cover every recording need.

34. "All the Best from *Sony*" is an 8-page booklet describing *Sony-Superscope* products—tape recorders, microphones, tape and accessories. Get a copy today before you buy!

35. If you are a serious tape audiophile, you will be interested in the all new *Viking Telex* line of quality tape recorders.

TELEVISION

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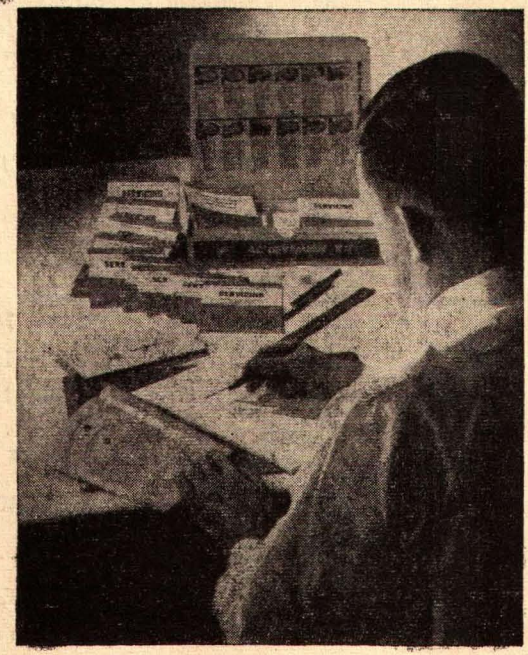

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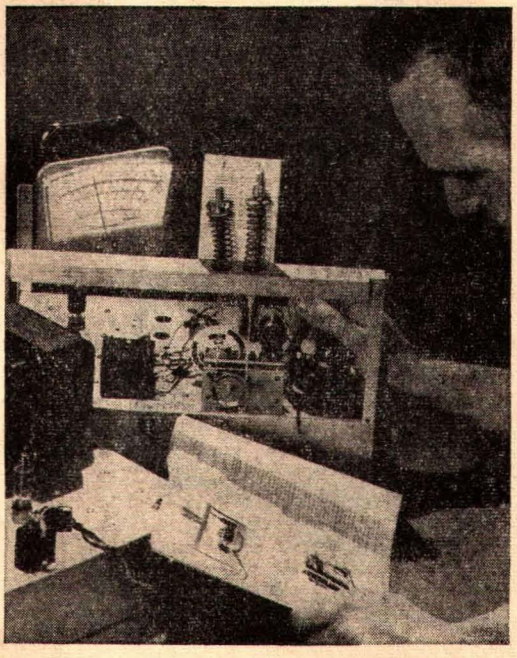
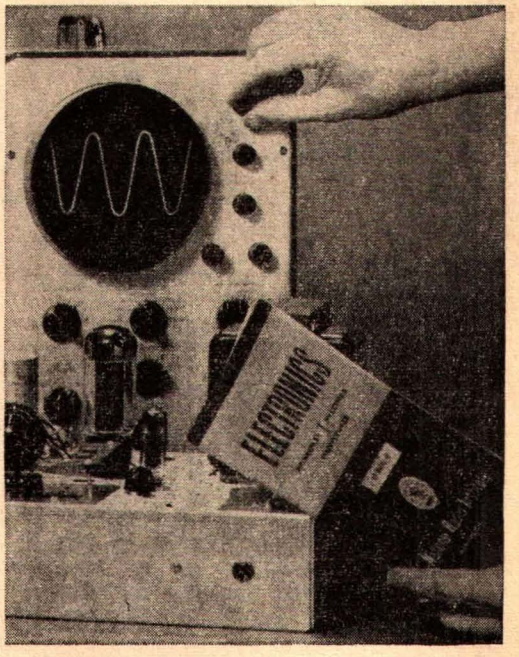
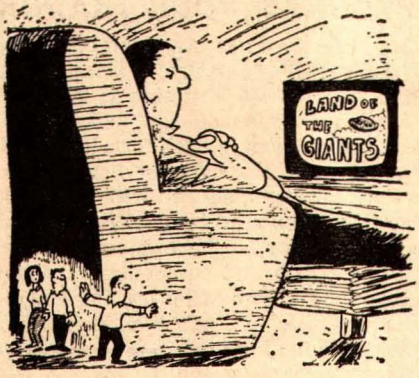




TINY TOPICS

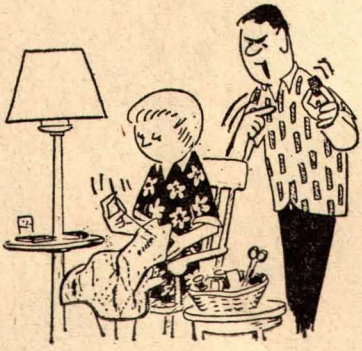
by Jack Schmidt



"You have a new stereo on display?"

"... but, I thought it was dirt on top of your workbench..."

"Nope, it's not a ring for you. It's a new mini-mite transceiver!"

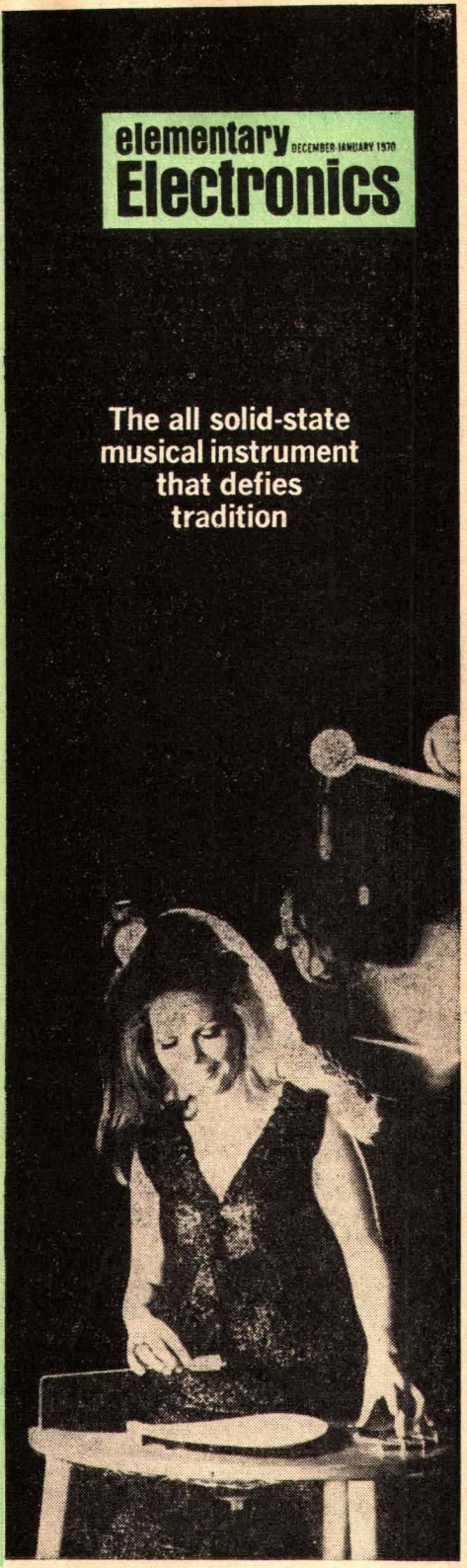


"That needle happens to be the antenna from my mini receiver!"

"Yes, Chief, we finally found that outlaw station that's operating mobile!"

VibraVox

by Charles D. Rakes

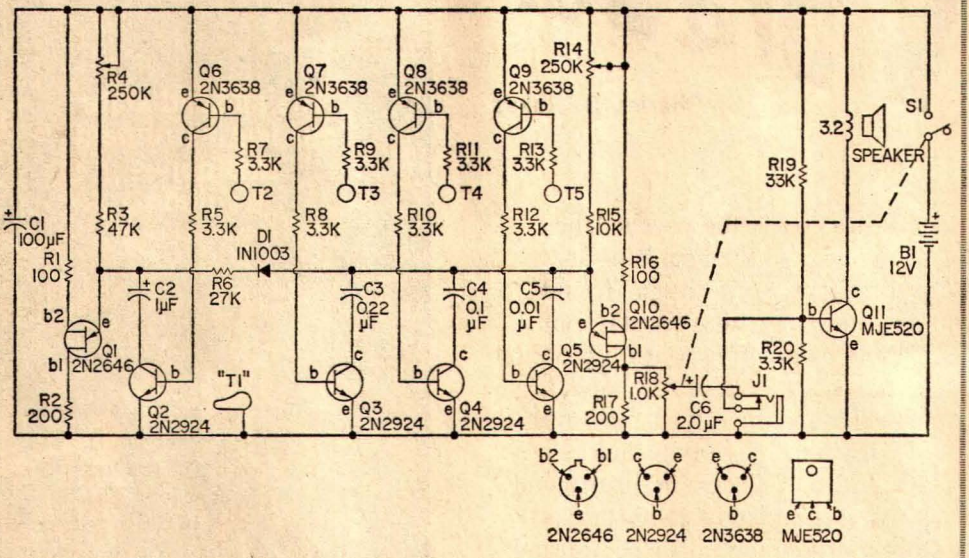


VibraVox is the psychedelic wonder of the age. With it you thrill all your "be-in" friends, terrorize and/or frustrate your neighbors by creating weird discordant musical sound effects, and, with perseverance, you may even learn to play tunes on it. This odd-ball electronic instrument is a completely solid-state device, producing all those unusual sounds. It can be played by any member of your family, or for that matter, by any bystander brave enough to spread the five fingers of his left hand over the five "touch contacts." The VibraVox's tear-drop shape has a practical aspect in addition to having an *in* decorative appeal. Playing the instrument is facilitated by providing ample space to group the five "touch contacts" in one convenient place, and in addition, it contains the balance of the components comprising the

complete instrument without making it a bulky piece.

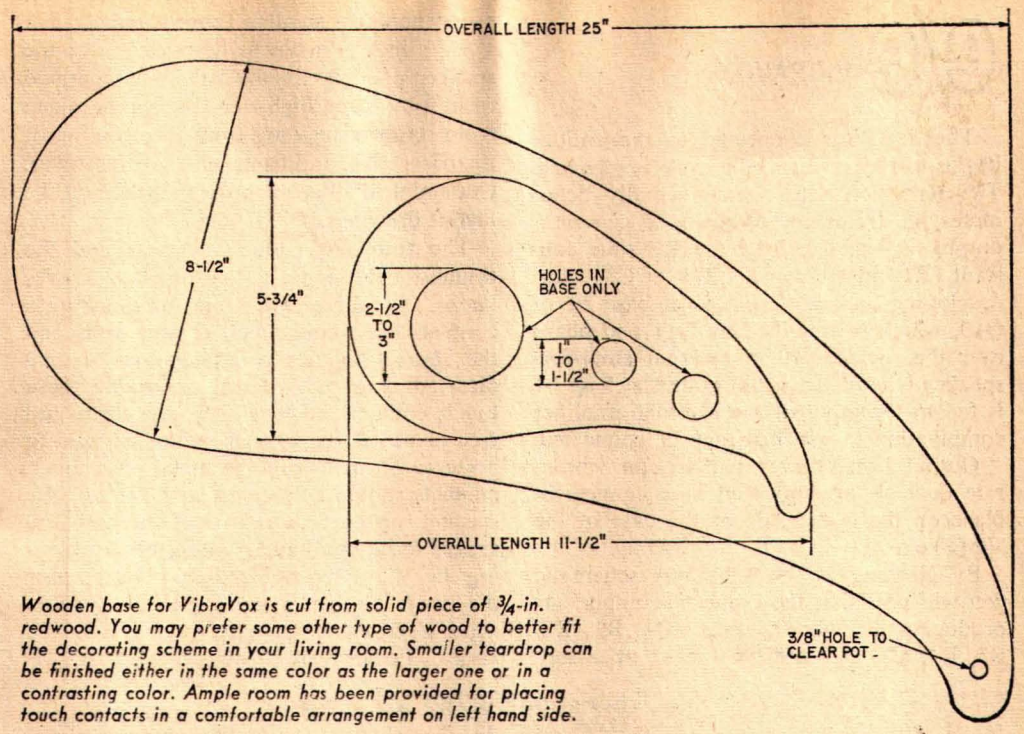
Essentially, the five "touch contacts" make it possible for the player to cause transistors to switch circuits for the specific functions of both tone generation and vibrato when playing this creation. The frequency of any of the tone ranges selected is continuously variable, in three stages, from 130 Hz to over 2000 Hz by manipulating a "shift lever" while playing the VibraVox.

Just in case the self-contained amplifier/speaker combination doesn't have enough power output to shake the rafters of your pad, an output jack connected ahead of the built-in amplifier/speaker lets you feed the



PARTS LIST FOR VIBRAVOX

B1—12-V battery, made of 8 1½-V cells (Burgess type 930 or equiv.)
C1—100-uF, 15-V electrolytic capacitor (Allied 43A6633 or equiv.)
C2—1-uF, 50-V electrolytic capacitor (Allied 43A1784 or equiv.)
C3—0.22-uF, 200-V tubular paper capacitor (Allied 43A5146 or equiv.)
C4—0.1-uF, 200-V tubular paper capacitor (Allied 43A5122 or equiv.)
C5—0.05-uF, 200-V tubular paper capacitor (Allied 43A5121 or equiv.)
C6—2-uF, 50-V electrolytic capacitor (Allied 43A6642 or equiv.)
D1—Motorola type 1N4003 silicon diode (Allied price 60¢)
J1—Closed circuit phone jack (Allied 16A3467 or equiv.)
Q1, Q10—GE or Motorola type 2N2646 unijunction transistor (Allied price $2.10)
Q2, Q3, Q4, Q5—GE npn silicon transistor type 2N2924 (Allied price $1.53)
Q6, Q7, Q8, Q9—Raytheon type 2N3638 silicon, planex, epoxy transistor
Q11—Motorola silicon power transistor type MJE520 (Allied price $1.38)
R1, R16—100-ohm, ½-watt resistor
R2, R17—200-ohm, ½-watt resistor
R3—47,000-ohm, ½-watt resistor
R4—250,000-ohm potentiometer, linear taper (Allied 46A1623 or equiv.)
R5, R7, R8, R9, R10, R11, R12, R13, R20—3300-ohm, ½-watt resistor
R6—27,000-ohm, ½-watt resistor
R14—25,000-ohm potentiometer, linear taper (Allied 46A1620 or equiv.)
R15—10,000-ohm, ½-watt resistor
R18—1000-ohm potentiometer, linear taper with switch (Allied 46A5301 or equiv.)
R19—33,000-ohm, ½-watt resistor
S1—Switch, mounted on R18 (Allied 46A5359 or equiv.)
2—4-cell battery holder (Allied 18A5904 or equiv.)
1—6 x 9-in. oval speaker, 3.2-ohm voice coil (Allied 16A3467 or equiv.)
Misc.—Four 1-in. dia. chrome-plated drawer pulls, one tear-drop chrome-plated drawer pull (available at Montgomery-Ward), ¾ x 9¼ x 27 in. wood for base, 6 x 12 x ¼-in. plywood or hardboard, three 6 or 29-in. legs and angled mounting brackets, ¼-in. drill rod for shift lever, gear shift knob, ½-in. spacers, perf board, push-in terminals or flea clips, hookup wire, solder, screws, bolts, nuts, etc.

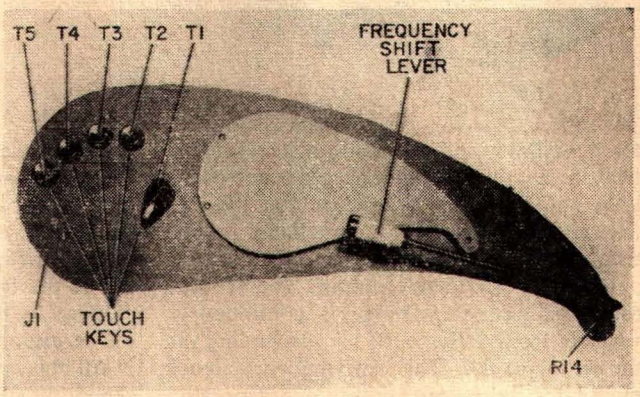


Wooden base for VibraVox is cut from solid piece of ¾-in. redwood. You may prefer some other type of wood to better fit the decorating scheme in your living room. Smaller teardrop can be finished either in the same color as the larger one or in a contrasting color. Ample room has been provided for placing touch contacts in a comfortable arrangement on left hand side.

output of the VibraVox to your hi-fi amp and speakers. Friends, enemies and innocent bystanders had better come prepared —be sure they have earplugs with them.

The How of It. The tone generator is an FET relaxation oscillator having three ranges to cover the overall range of the VibraVox. The basic frequency of each range is established by the capacity of the particular range capacitor (C3, C4, or C5) switched into the oscillator circuit, plus the total amount of resistance that is in the circuit (determined by the position of the arm of potentiometer R14, which is mechanically coupled directly to the shift lever. Range selection is effected by electronic switching accomplished by finger contact between touch contacts T1 and T3, or T4 or T5.

What happens is that body resistance between the fingers touching T1 and any one of the other touch contacts causes the respective transistor connected to that contact to conduct, which starts the second transistor connected to it conducting. This, in turn, causes current to conduct through the base B1 of UJT (Q10). The junction voltage at the emitter of this transistor is clamped almost to ground and current through the transistor then decreases and the transistor is driven to cut-off. *(Turn page)*

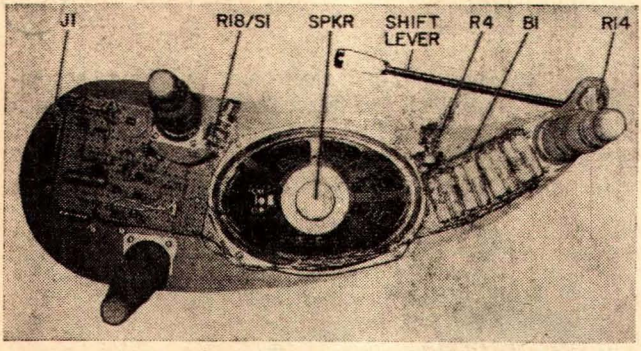


This operating side view of VibraVox shows how all controls are conveniently placed to facilitate playing the instrument. Touch keys, mounted to left, are arranged at time of assembly to comfortably fit the span of the player's hand. Frequency shift lever, mounted on right side of instrument, has lever extending to left.

The capacitor connected to the emitter begins to recharge and the cycle is repeated. The repetition rate, which actually determines the frequency of the tone generator output, is established by the RC time constant (R14 plus either C3, C4, or C5), thus developing an audio voltage at base b1 of Q10, which is amplified by Q11 and heard over the speaker. If an external amplifier-speaker is used the audio output at base b1 is fed to the input of the external amplifier combination to which it may be connected.

Output level, power switch, and vibrato rate controls are mounted in a convenient place on the under side of the base of the VibraVox.

By glancing at the VibraVox schematic you will note that the group of components producing the vibrato effect (Q1, R1, R2, R3, R4, C1, Q2, and Q6) make up a separate oscillator and electronic switcher, identical in circuitry to the tone generator oscillator and its switchers, except that the RC time constant values for the oscillator are not the same in order that they might produce a much lower frequency output. The vibrato oscillator frequency range is continuously variable from 2 Hz to 20 Hz, depending on the setting of R4. This low frequency signal modulates the output of the tone generator oscillator at a rate dependent on the output frequency of the vibrato oscillator.



Bottom view of VibraVox clearly shows location of various sections of complete instrument. Oval speaker provides larger cone to improve overall response of instrument. Batteries are easily replaced by merely slipping old ones out of carrier and slipping new ones in. This type of battery holder makes it easy. All electronics with exception of frequency and volume controls and vibrato rate control, are mounted on single perf board.

Building It. The complete unit, including the batteries to operate the oscillator, amplifier, and electronic switching, is mounted on a piece of redwood (or other wood of your preference) 8½ x 25 x ¾ in. formed into the shape of a tear drop. A smaller piece of ¼-in. plywood (or hardboard) cut so that it's a mirror image of the base tear drop, but proportionately smaller (approximately 5¾ x 11½ in.) is made to be placed over the speaker openings in the base but separated from it by ¾-in. high wooden spacers, made from scraps remaining from the forming of the base, shaped to fit the ends of this cover. Cut and drill all of the holes indicated on the layout drawings.

The four finger-touch contacts and the thumb-touch contact are metal drawer knobs. The three-tone range and the vibrato contacts are round metal drawer pulls and the thumb contact is a tear-drop shaped metal drawer pull. Before mounting these touch contacts be sure they are clean and free of protective lacquer or shellac used to preserve the polish of the metal. The touch contacts should be located at the left of the speaker, on the widest part of the base, arranged to fit your hand comfortably for playing the Vibravox. Solder lugs placed under the heads of their mounting screws enable good electrical contact to be made to the knobs. Power switch, output level and vibrato rate controls are mounted on angle brackets fastened to the underside of the base. The range control (R14) is mounted on the narrow end of the base so that the potentiometer shaft sticks up through the top of the base far enough to fasten a shaft coupler to it for joining the shift lever to the potentiometer shaft.

All the components making up the tone generator and vibrato oscillators, as well as the amplifier, with the exception of R4, R14, R18, J1, S1, the speaker and battery B1, are mounted on a 6¼ x 4¾-in. piece of perf board. A 2 x 3-in. corner of the board is notched out to accommodate the mounting of a metal leg support to the wooden base. Three ½-in. spacers are used to raise the perf board from the base to which it is fastened to permit wires to pass under it. We used push pins to mount and con-

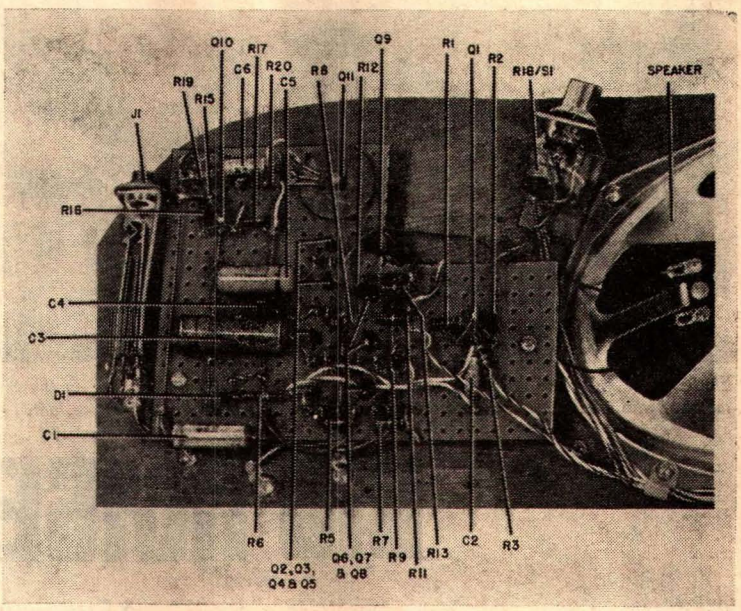
nect the various components on the perf board. A word of caution: do not overheat the leads to the transistors and diode or the electrolytic capacitors. Excessive heat damages them. It is suggested you use an alligator clip as a temporary heat sink when soldering these parts, temporarily clipping it to the lead being soldered. One other word of caution, be sure you have the transistors properly oriented before soldering and be sure that polarity of electrolytic capacitors and the diode is correct. You get only one chance, so taking precaution to doublecheck your wiring before soldering is well worth the time spent.

Cut a copper or aluminum disc about 1½-in. in diameter to serve as a heat sink for the power transistor.

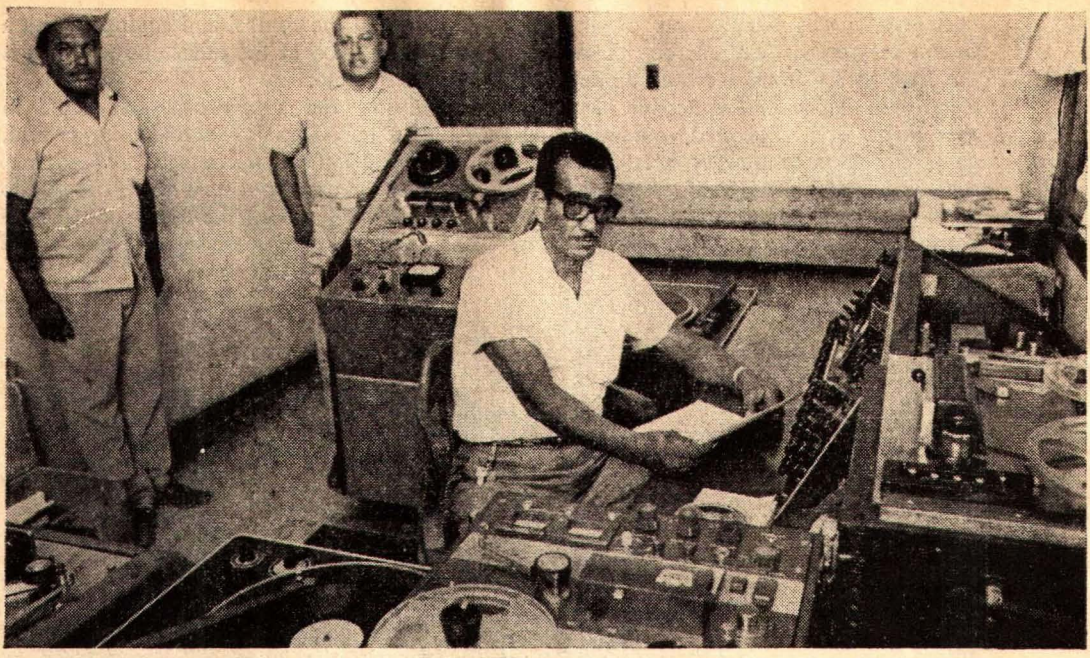
Batteries are held in two, four-cell battery holders fastened to the under side of the base as shown in the photos. The unit can be fitted with three short legs (6 in. long) for table top mounting and playing or with three long legs (29 in.) to make it self supporting, yet high enough from the floor to be able to sit in a chair when playing it.

Resistor R14, the frequency shifting control, is mounted centered on the small end of the tear drop base. To conveniently operate the frequency shifting variable resistor a "shift lever" is made from a length of drill rod, bent at a right angle about 3 in. from one end and mechanically coupled to the shaft of the control and equipped with a gear shift knob at the other end to make it easy to operate.

Playing the VibraVox. Be seated in front of the VibraVox, with the larger end, containing the touch contacts, at your left. Turn on the power switch, place the thumb of your left hand on the thumb-touch contact and one finger on any of the range contacts to develop the tone range desired. The right hand is used to shift the lever back and forth to vary the tone generator frequency through its span to achieve the tones desired. By moving the finger so different range contacts are touched to select a range and shifting the tone tuning lever you will produce tones that, when properly selected, will develop a tune. To create the vibrato effect place another finger on the touch contact for the vibrato oscillator (T2) and adjust its frequency control (R4) for the desired rate of vibrato. Remember, like any other instrument, it takes practice to play it, so if a delightful melody is to be produced, all we can say is practice-practice. In this age of electronic musical instruments any electronic devices that produce tones can be classified as musical instruments. True, some of the effects from them may appear to some listeners to be weird, but for others they certainly provide a means to satisfy the desire for pioneering. Why not get your start in electronic music by building VibraVox? ■



Heart of VibraVox is the electronic tone generator and vibrato generator shown here. Note that all of components are mounted on a piece of perf board, except for various controls which are distributed in convenient locations on baseboard. Basic layout isn't critical; however, one shown here does place components advantageously for interwiring.



Elado Delos, the engineer responsible for keeping XERF's transmitter on the air, is the only operating staff member who manages some English. Technical quality of the station is excellent.

BIG NOISE FROM

XERF waves the flag of religion to

Since the programming is aimed at rural America, all announcements are taped in English. Paul Kallinger, who may be called the station's only staff announcer, is shown here taping a commentary. The improvised studio is a converted chicken coop.

If you happen to be driving along a distant highway some evening and you're twirling the radio dial to find a station, you might pick up a plummy, male baritone saying something like, "How do you do? How do you do? How do you do? We're sure glad to have you out there listening to our program, *Gospel Request Time*." There comes the first and, apparently, only request—a hillbilly hymn. This is followed by a commercial message that may run anywhere from three to fifteen minutes: "I hope many of you folks out there will see the light tonight and ask Jesus to forgive them. And I hope many of you people who need and want to quit smoking will ask us to send you . . ." Don't turn the dial. Stay tuned in for a while out of curiosity. You are listening to the largest commercial radio station in existence in North America.

XERF's transmitter, located just over the Texas border in Acuna, Mexico, is rated at 250,000 watts, five times more powerful than any station authorized by the FCC in U.S.

THE BORDER

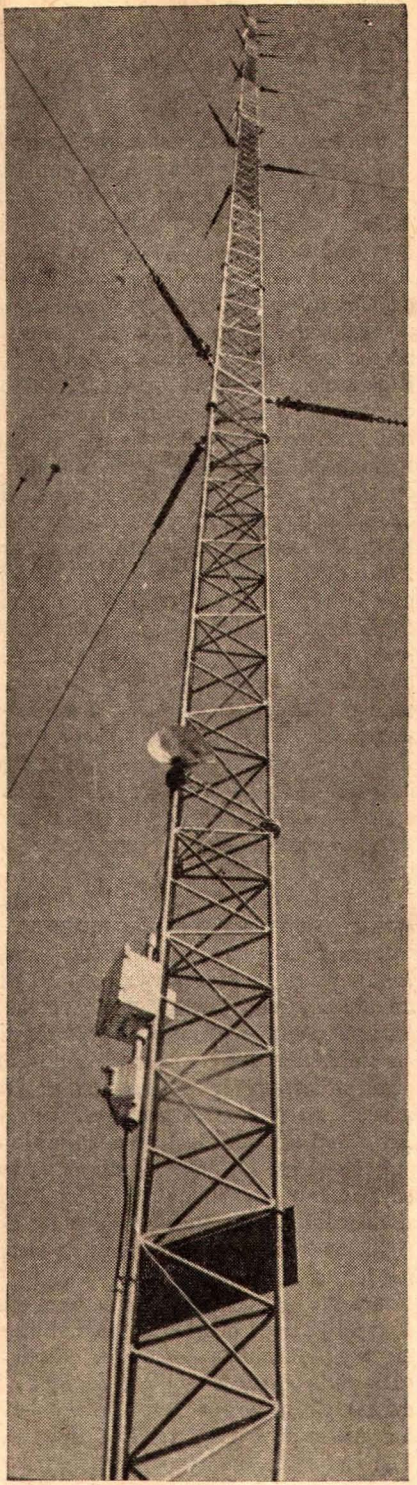
hide the crass profits of commercialism.

by Arthur Whitman

There's nothing else quite like it on the air.

The widest radio coverage in America does not belong to any U.S. outlet or even network, but to Station XERF at 1570 kHz on the AM band. The station's transmitter, located near the Texas border in Acuna, Mexico, is rated at 250,000 watts, five times more than the 50,000 the FCC allows any U.S. station. XERF operates under its own rules, sandwiching only a few country and western tunes, oldtime hymns and rock favorites between barrages of hard sell commercials.

Watt Power. Owners of radio sets in all 50 states and Canada can theoreticaly receive its signal during its broadcast period from 5:30 P.M. to 8:00 A.M., especially on clear, chill nights when cool temperatures soothe the airwaves and many local stations that might interfere are off the air. XERF also reaches halfway around the world, as frequent letters attest from listeners in Argentina, New Zealand, Japan, and a dozen other faraway places. *(Continued overleaf)*



"Torre Antena," as it is referred to by the station's Mexican employes, soars 295 ft. above the desert, beaming a signal over most of N. America.

BIG NOISE

Since almost all of the programming is taped in English and aimed at rural American audiences, and since its mailing address is Del Rio, Texas, most listeners have no idea they are tuned to a Mexican station. XERF is, in fact, owned by *Compania Radifusora de Coahuila, S.A.*, a Mexican corporation that appears, to all intents and purposes, to be the property of Arturo Gonzales, a Del Rio attorney. Gonzales, who is completely camera shy, allows interviews only in the role of "legal adviser to the corporation." Indications are, though, that he has been operating the station and making all its key decisions since it went on the air in 1946. Its manager's office is in Acuna, and its 295-foot transmitter and the rundown buildings housing its transformers and associated equipment are in barren desert south of town. The transmitter can be reached only by roads so nearly impassable that the ten-mile trip takes about an hour in the ranch wagon the company operates to shuttle its six technicians to and from work. Though its 14½ hours of daily programs are almost entirely in English, nobody speaks it at the station, and nobody even really understands it.

Gonzales refuses to discuss the station's earnings, and no one else seems to know what they are, but an estimate is possible. A few years ago, rates were $87.50 per 15-minute segment of broadcast time, or $350 an hour. With allowances for some unsold air time, that still represents a tidy annual gross of about 1½ million dollars. This is a gross many better known stations would envy, and the net must be even more enticing. There are virtually no running expenses beyond low Mexican wages (by American standards) for a technical and office staff of eight, and the cost of generating electricity for the transmitter.

Cost is Low. Since all broadcast material is taped, talent costs next to nothing. The biggest outlay now is for a one-hour taped rock and roll show mailed in daily by Wolfman Jack, a Los Angeles disc jockey who has never seen Del Rio, let alone Acuna. The only other visible talent is Paul Kallinger, whose overripe announcer's voice is heard at sign on and sign off, and on occasional other spots throughout the broadcast period. Once a full-time XERF employee, Kallinger now runs a restaurant in Del Rio. He tapes the two or three new spots the station needs each week in a chicken coop he has converted to a studio. Price per tape: $8.

In its halcyon period a few years ago, XERF did even better than it does now. Then it was almost entirely a mail order station, huckstering everything from potency pills to insurance, religious trinkets and bibles. Advertisers paid so much per inquiry or order which came directly to the station. The price for leads and orders ranged from 25 cents for patchwork quilt pieces to $5 a lead from a Midwestern insurance company hustling an all-purpose family policy. With inquiries coming in from every state in the union at the rate of about 20,000 a day, the station did, by Kallinger's estimate, "right well, indeed."

These days, because so many former mail order items are now sold through stores at far lower prices, the station's direct mail order business is way down. Items that don't attract more per inquiry money than can be obtained from straight time charges are sloughed off ruthlessly. Also, the spread of TV has siphoned off some of the steady, at-home listeners. But XERF still moves enough people to buy things to satisfy advertisers. Current mail order winners include genuine simulated diamond rings, stop-smoking pills, weight reducing pills and, still, low-cost family insurance.

Have Faith. The big money now, though, goes directly to the sponsors, many of whom are preachers who tape their spiels and mail them to the station along with a check to pay for broadcast time. Some are healers, like Brother Glen Thompson, who gets his mail in Hot Springs, Arkansas. "That woman down there with arthritis," he screams on his tape, "send in your request. That woman in the kitchen just now who is suffering with a bad tumor—God wants you to send in your request! Obey the voice of God in you by giving me as much as you can, and God will give back. And if you send in five dollars or more, request the nativity Bible. It is such a beautiful Bible, with maroon binding. . . ."

Some of the pitches make even more unabashed use of religion. "Friends, is it not right that I should ask you to support our work?" asks a Mississippi minister of unknown credentials. "You write me whether you've got money to send or not. But if you have something you can send to us to help

(Continued on page 109)

THE UNICORN

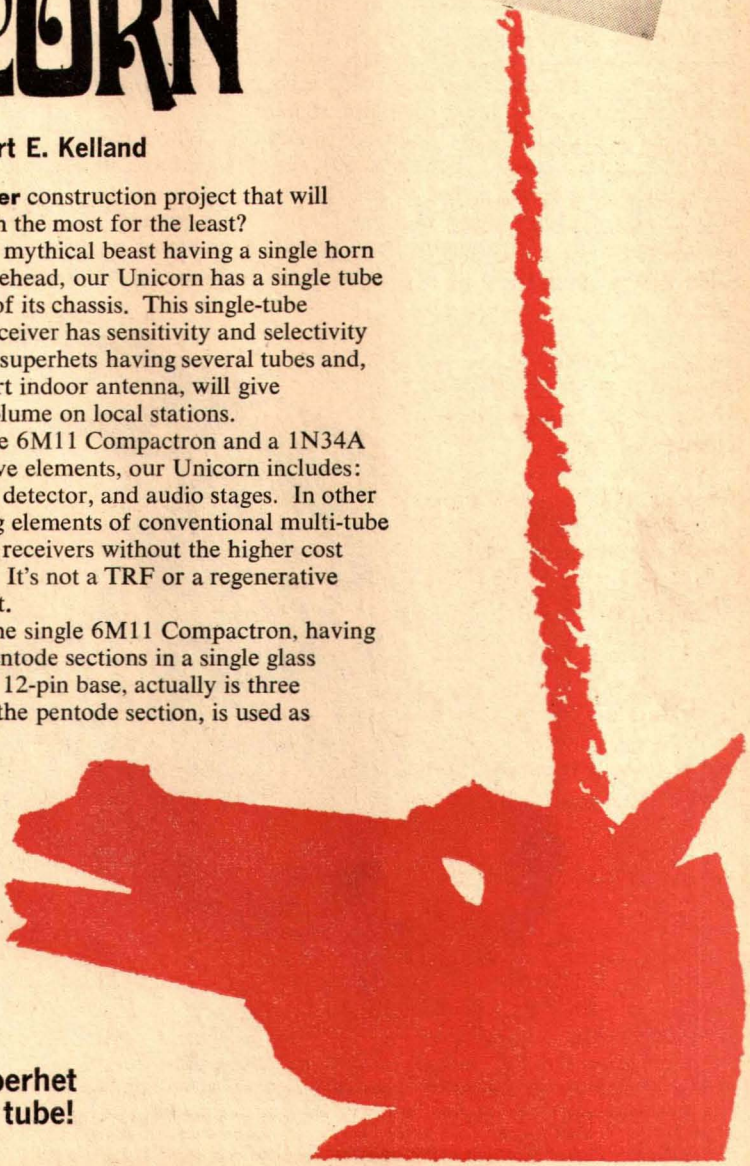
by Robert E. Kelland

Want to try another construction project that will provide you with the most for the least?

Like the unicorn, a mythical beast having a single horn in the center of its forehead, our Unicorn has a single tube located in the center of its chassis. This single-tube superhet broadcast receiver has sensitivity and selectivity that is comparable to superhets having several tubes and, when using just a short indoor antenna, will give reasonable speaker volume on local stations.

Employing one type 6M11 Compactron and a 1N34A diode as the only active elements, our Unicorn includes: RF, oscillator, mixer, detector, and audio stages. In other words, all the working elements of conventional multi-tube or transistor superhet receivers without the higher cost for several tubes, etc. It's not a TRF or a regenerative set, it's a *true* superhet.

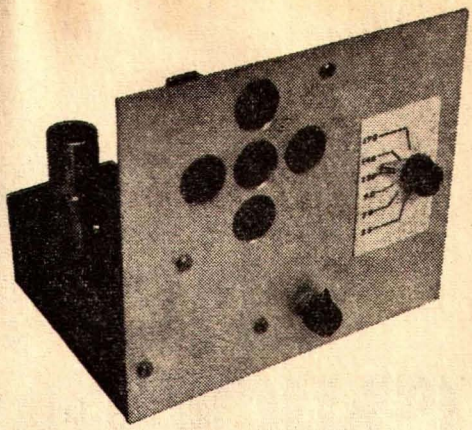
How It Works. The single 6M11 Compactron, having two triode and one pentode sections in a single glass envelope fitted with a 12-pin base, actually is three separate tubes. V1A, the pentode section, is used as



No kidding, a complete Superhet using just one tube!

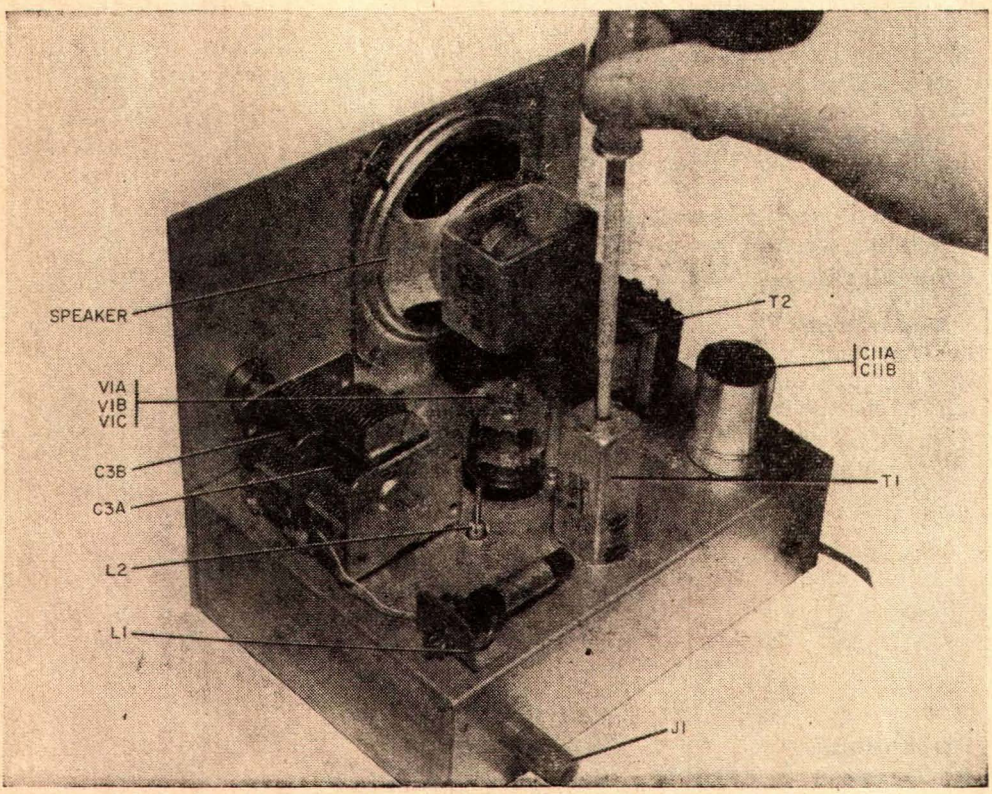
RF amplifier, oscillator, and mixer. V1B, one of the triodes, serves as the IF amplifier, and V1C, the other triode, is the audio amplifier/power output stage of the Unicorn. A 1N34A diode is the detector.

RF signals fed into the receiver from the antenna are selected by the tuned RF circuit (L1, C3A), which inherently doesn't have the selectivity required to easily separate the closely spaced AM broadcast stations. The superheterodyne circuit effects the higher selectivity by developing a narrow band signal to be amplified by the IF stage, which is tuned to a specific frequency. (455 kHz in the Unicorn). The local oscillator signal is mixed with the broadly tuned RF signal and produces a resultant (heterodyned) narrow band signal which is fed to the IF amplifier. The sharply tuned IF transformer (T1) rejects all but the narrow band heterodyned signal and feeds it into tube V1B.



Front view of the Unicorn shows clean lines and simple panel layout. No attempt was made to provide an artistic masterpiece, just a utilitarian layout.

When the RF section of the receiver is tuned to a station, the oscillator is also tuned because both tuning capacitor rotors are on a common shaft. This is commonly called oscillator tracking. This ensures the heterodyned signal will always be at 455 kHz, the



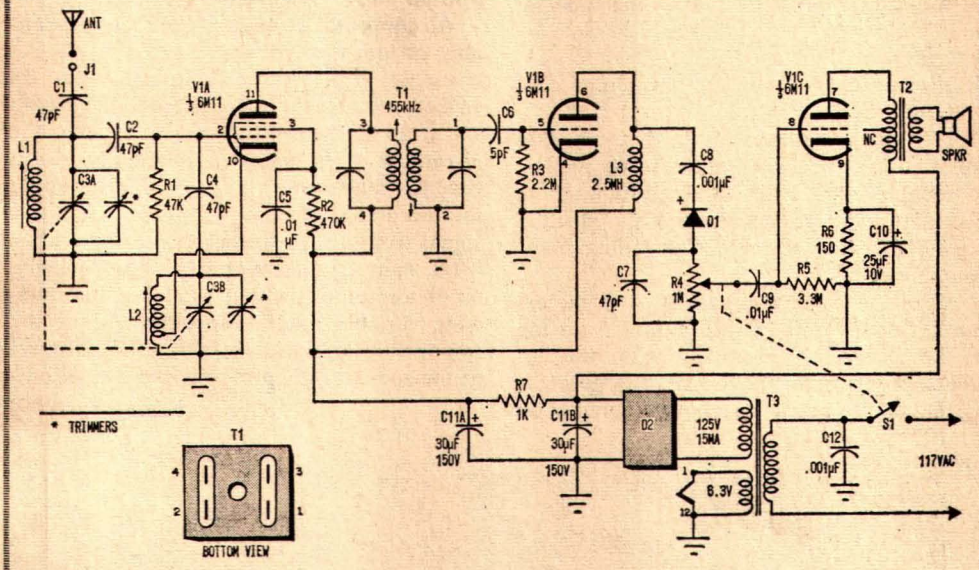
Rear view of chassis shows locations of the various parts on the top of the chassis pan. A simple right angle bracket is used to mount L1 to the chassis. It can be made from aluminum channel 1/2 x 1/2-in. IF transformer T1 tuning slug is being adjusted for maximum signal. Use a plastic tuning tool for this.

working frequency of the IF transformer.

The 455 kHz amplified output signal of the IF stage is detected by diode D1 and the audio portion is extracted and fed to the remaining triode section where it is amplified and fed to the speaker so it can be heard.

The Unicorn contains its own 117 VAC power supply. The 6.3 VAC for the 6M11 filament is obtained from the low voltage winding of power transformer T3. Direct current for the receiver is provided by the packaged bridge rectifier D2 and filtered by capacitors C11A and C11B and resistor R7.

Let's Build It. The complete receiver, with the exception of the speaker, is built in and on a 5 x 7 x 2 in. aluminum chassis. The speaker is mounted on the front panel, which is a 6 x 7 x 1/16-in. sheet of aluminum. We didn't attempt to make the front panel an artistic masterpiece. You may want to



PARTS LIST FOR UNICORN

C1, C2, C4, C7—47-pF, 1000-V ceramic disc capacitor (Lafayette 32T0160 or equiv.)

C3A, C3B—2-gang variable capacitor, front section 10.5-pF to 365-pF, rear section 7.6-pF to 132-pF (Lafayette 32T1101 or equiv.)

C5, C9—0.01-uF, 600-V ceramic disc capacitor (Lafayette 33T2337 or equiv.)

C6—5-pF, 1000-V ceramic disc capacitor (Lafayette 32T0147 or equiv.)

C8, C12—0.001-, 1000-V ceramic disc capacitor (Lafayette 33T2311 or equiv.)

C10—25-uF, 12-V electrolytic capacitor (Lafayette 34T8502 or equiv.)

C11A, C11B—30-30-uF, 150-V electrolytic capacitor (Lafayette 34T7672 or equiv.)

D1—1N34A diode

D2—Bridge rectifier, 400 PIV working volt, 1.5 A, 280 VRMS (Erie FWR3004A or equiv.)

J1—Binding post (Lafayette 99T6121 or equiv.)

L1—High Gain Loopstick antenna coil for use with 365-pF variable capacitor (Lafayette 32T4106 or equiv.)

L2—Universal oscillator coil (Lafayette 34T-8704 or equiv.)

L3—2.5-mH RF choke (Lafayette 32T5118 or equiv.)

R1—47,000-ohm, 1/2-watt resistor

R2—470,000-ohm, 1/2-watt resistor

R3—2,200,000-ohm, 1/2-watt resistor

R4/S1—1,000,000-ohm potentiometer, audio taper, with spst switch

R5—3,300,000-ohm, 1/2-watt resistor

R6—150-ohm, 1/2-watt resistor

R7—1000-ohm, 1/2-watt resistor

S1—Part of R4

T1—IF transformer, 455 kHz (Lafayette 32T-0946 or equiv.)

T2—Universal output transformer (Lafayette 33T7503 or equiv.)

T3—Power transformer, 117-VAC pri., 125-VAC @ 15 mA sec., and 6.3-VAC @ 0.6 A sec. (Lafayette 33T3405 or equiv.)

V1A, V1B, V1C—GE type 6M11 Compactron multi-section tube

1—5 x 7 x 2-in. aluminum chassis (Lafayette 12T8195 or equiv.)

1—Compactron socket (Lafayette 33T8701 or equiv.)

1—4-in. PM speaker, 3.2 ohm V.C. (Lafayette 99T6268 or equiv.)

1—AC line cord (Lafayette 12T3901 or equiv.)

Misc.—Hardware, hookup wire, solder, knobs, perforated metal 1/16-in. aluminum sheet, grommets, tie strip, etc.

make yours more attractive by restyling the dial plate and/or the speaker grille.

We made our speaker grille by punching four ¾-in. holes in the simple pattern shown in the photo, using a standard chassis punch, and backed them up with plain perforated metal to protect the speaker cone. (It was all we had in the stock pile at the time we built Unicorn.) We made the dial plate by lettering a 1¾ x 2¾ in. piece of white plastic sheet in black letters for the tuning calibration points.

It is suggested that for best results you follow our layout as detailed in the photos, to maintain short leads where we found them necessary, and to advantageously position parts for ease in wiring and to reduce intercoupling problems.

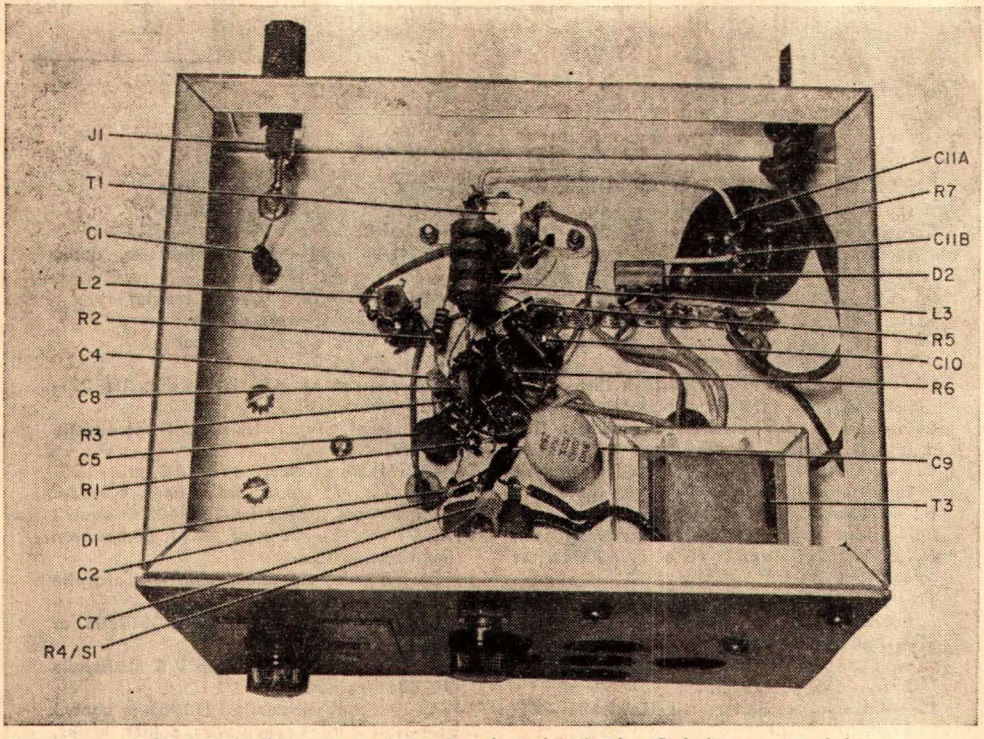
All of the major components with the exception of T3 and D2 are mounted on top of the chassis. T3 is mounted on the left front apron inside the chassis. Bridge rectifier D2 is also inside the chassis mounted on a 5-terminal plus grounding lugs at each end tie strip.

Potentiometer unit R4/S1 is centered on the front apron inside the chassis with the control shaft protruding out front for the control knob. The antenna coil (L1) is mounted on top of the chassis by employing a small right angle bracket.

After all wiring has been completed, double-check it for accuracy against the schematic before inserting the power cord into an outlet and turning on the power.

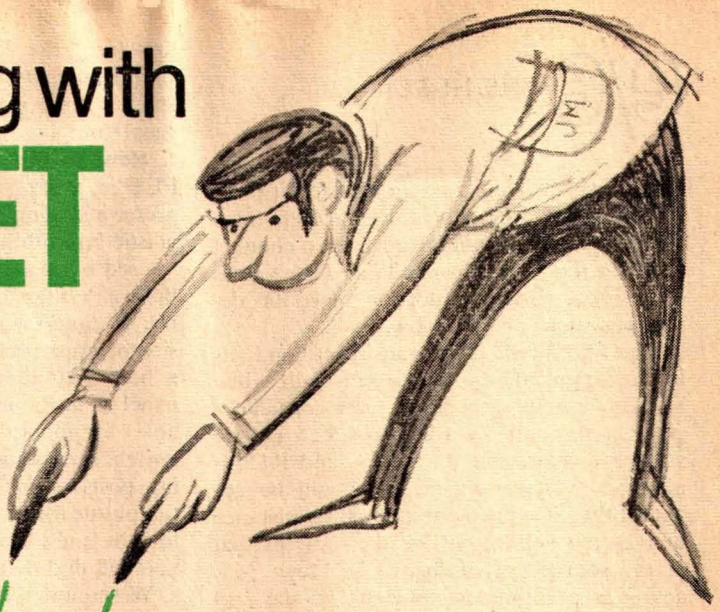
Alignment. Now that you are reasonably certain that you have wired up the set correctly, insert the Compactron in its socket, turn on the receiver, and allow it to warm up a few minutes before starting the alignment. The first step in aligning is to tune IF transformer (T1) to 455 kHz. To do this accurately, feed a 455 kHz modulated signal from a signal generator to the grid of V1A (pin 2). Temporarily short out the oscillator tuning section (C3B) of the two-gang variable tuning capacitor. Adjust the tuning slug of T1 for maximum signal level at the speaker. It's preferable to use an out-

(Continued on page 109)



Bottom view of chassis with all components located on the underside identified. It is suggested that you follow this layout in order that all leads will be as short as possible and you'll have a minimum amount of wiring. In most cases the parts are wired from point to point with their leads.

debug with HI-FET



by Steve Daniels, WB2GIF

The VOM has always been considered "Old Faithful" by electronics technicians and experimenters, and for good reason. Its single meter provides you with the means to make accurate measurements of voltage and current on most circuits, as well as resistance measurements, that would require many separate meters if the VOM was not available.

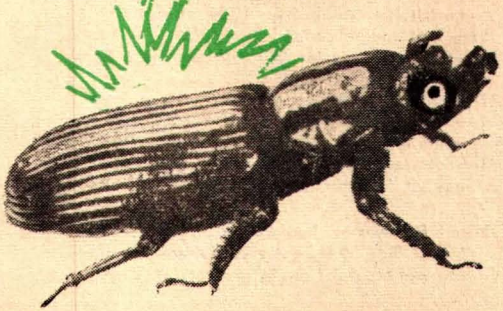
You must have noted that we said: "on most circuits." Let's consider the diagram for a voltage divider circuit in the output of an oscillator type power supply. This voltage divider has been designed to deliver + 15V at point A; however, our VOM doesn't read + 15V when connected to this point. Why doesn't it?

Think about this for a moment: the VOM is a 20,000-ohm-per-volt instrument, so, when it is set on the 50V range its input resistance is approximately 1 megohm. In all probability it is possible that this total resistance is not much more than the total resistance of the voltage divider under test. If this be the case, then, the voltage divider design criteria is changed by our VOM acting as a shunt to the voltage divider resistance.

To prove this theory we borrowed a vacuum tube voltmeter (VTVM) and made the same test. This time the voltage at point A read exactly + 15V, the correct voltage for which it was designed. The moral of this is that a VOM cannot be depended upon for accurate voltage readings on low-impedance circuits.

How does one overcome this? By spending $30 to $50 or more for a commercially manufactured VTVM, or else, by building our HI-FET voltmeter for about $20 (depending on how many of the parts are already on hand in the surplus parts box in your shop). In addition to acquiring a most useful and necessary piece of test equipment you will have gained experience in building and calibrating test equipment.

What Makes It Work? The HI-FET



Just a little of your time and money will produce an instrument that is big on utility

circuit was evolved from an old circuit for a VTVM employing a pentode vacuum tube. We substituted a general purpose n-channel FET for the pentode and changed the values of resistors and capacitors to meet the design parameters of the FET.

The FET (field effect transistor) conducts in the drain (d) to source (s) path when no gate bias is present. If you consider a channel through the FET and R11 as one voltage divider, and R13, R14, and R15 as a second voltage divider, it should be apparent that at some point along the resistance of R14 the voltage will be the same as that at the source (s) of the FET. Meter M1, acting as a voltmeter connected to the arm of R14, will indicate zero voltage at this specific point along R14's total resistance since there will be no voltage difference.

When a voltage is applied (the meter is measuring a point in a circuit) to the input of the HI-FET the gate of Q1 is biased into conduction and the source (s) becomes more positive because of the increase in current of the transistor. Meter M1 will now indicate a voltage proportional to the voltage drop through the resistors of the voltage divider on the input of HI-FET that are being used for the range being used for the measurement. The total input resistance of the series string of R1 through R9, which makes up this divider is a constant 22.2 megohms, therefore, the loading it presents on any circuit under test is minimal. Capacitors C1 and C2 serve as filters to prevent stray voltages from upsetting the readings.

How To Make One. We housed the HI-FET in a 6 x 5 x 4-in. mini-box. You may prefer a sloping front meter box or a molded plastic box similar to those almost universally used by manufacturers of test equipment. Before settling on the size of the box you use to house your HI-FET, select a meter size of your preference or budget. First cut a hole just above the center in the front panel to fit the meter and then drill all other holes for mounting the range switch, *on-off* switch, zero adjusting pot and the input binding posts or jacks on this panel. Although the physical layout is not critical, if you follow the one we used, as shown in the photos, you will find that wiring will be simplified.

We mounted the FET, resistors R10, R11, R13, and R15, and capacitor C2 on a small piece of perf board that is held in place under the positive meter terminal. Potentiometer R12 is mounted on a bracket behind the panel since it is seldom re-set after the initial calibration, unless the battery has to be replaced. Potentiometer R14 and switches S1 and S2 are mounted on the front panel as are input connectors J1 and J2.

Both of these input jacks are insulated from the front panel. The metal cabinet has not been grounded to the circuit ground purposely so that negative voltages can be measured just by reversing the test leads in the input jacks without having to consider the possibility of shorts occurring should the

PARTS LIST FOR HI-FET

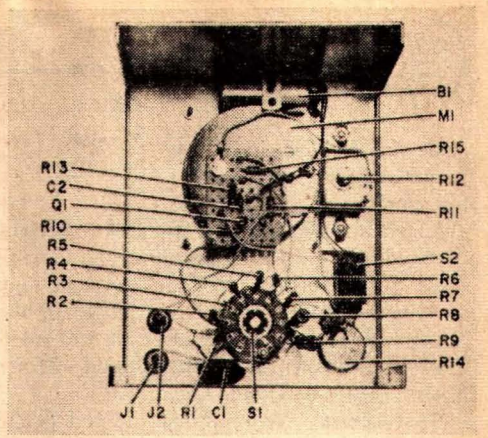
B1—9V transistor radio type battery (Eveready #216 or equiv.)
C1—0.04 or 0.05 uF, 1.6 kv ceramic disc capacitor
C2—0.003 uF, 1.0 kv ceramic disc capacitor
J1—Red, insulated jack for banana plug and phone tip (Lafayette 32E64843 or equiv.)
J2—Black, insulated jack for banana plug and phone tip (Lafayette 32E64850 or equiv.)
M1—0-50 uA microammeter (Lafayette 99T-50429 or equiv.) (see text)
Q1—General Electric type FET-1 field effect transistor
R1—2,200,000 ohm, ½-watt resistor
R2—10,000,000 ohm, 5% resistor
R3—8,000,000 ohm, 5% resistor
R4—1,000,000 ohm, 5% resistor
R5—800,000 ohm, 5% resistor
R6—100,000 ohm, 5% resistor
R7—80,000 ohm, 5% resistor
R8, R9—10,000 ohm, ½-watt resistor
(See text)
R10—1,000,000, ½-watt resistor
R11—47,000 ohm, ½-watt resistor
R12—5000 ohm linear potentiometer (Mallory type U14 or equiv.)
R13—51,000 ohm, ½-watt resistor
R14—2000 ohm linear potentiometer (Mallory type U6 or equiv.)
S1—11 position, sp, non shorting rotary switch (Centralab type 1001 or equiv.)
S2—Spst toggle switch, 3a-250V
1—Battery connector (Cinch-Jones type 5D or equiv.)
1—Battery holder (Keystone 203P or equiv.)
1—6 x 5 x 4 Mini-box (Premier PMC 1007 or equiv.)
1—Set test leads (H.H.Smith type 610 or equiv.) (see text)

Misc. Hardware, hookup wire, solder, perf board, flea clips, press on letters for marking panel, right angle bracket, etc.

cabinet of the HI-FET touch the chassis of the unit under test. Of course, if a plastic cabinet and panel are used this problem is solved automatically.

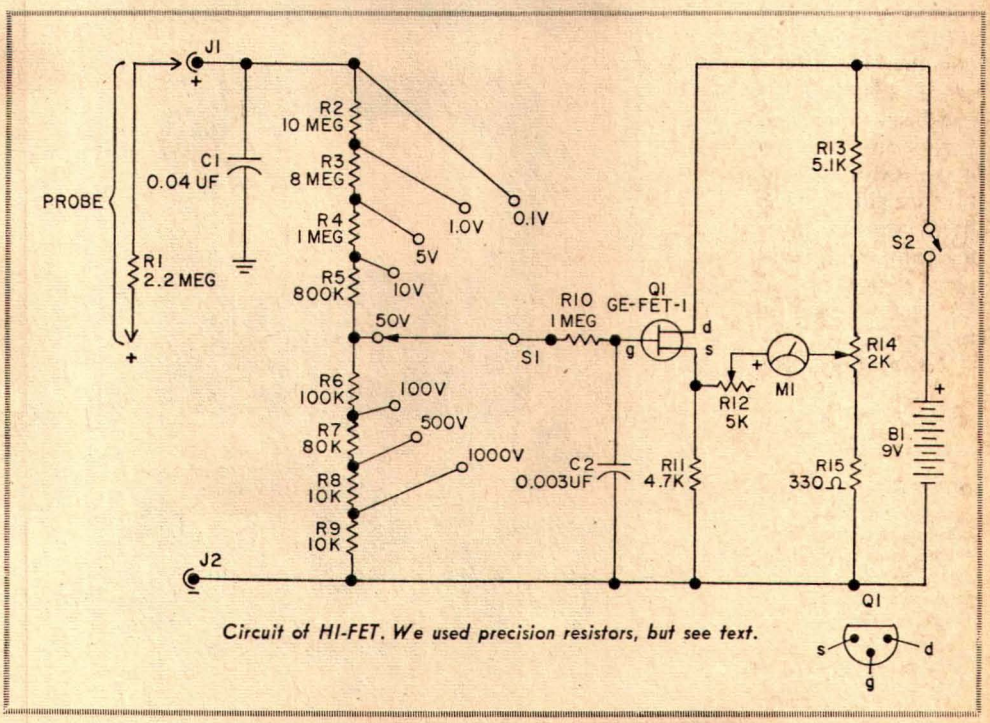
We mounted the 1% precision resistors R2 through R9 directly to their respective contact points on the range switch (S1). They are self supporting and are very easily mounted in this manner. You can of course, if you prefer, mount them on a separate piece of perf board and wire from the board to the switch contacts. Since the accuracy of readings is entirely dependent on the value of these resistors which make up the input voltage divider, we strongly recommend that if you can procure 1% resistors by all means do so, as the additional cost should be well worth it to you. Since we could not locate a readily available source for 1% resistors, particularly for the high resistance values required for R2 through R5, we have listed 5% resistors in the Parts List. These are easy to obtain and can be found in most suppliers' inventories.

Wire up the various components on the perf board before mounting it. Flea clips were used as take off points for leads to other components in the circuit. They also can be used as mounting and connecting points for the various parts fastened to the perf board. This method permits easier replacement of any part should this become necessary. We used a simple angle bracket to clamp the battery in place between the top of the meter and the top of the cabinet, behind the panel of course. You may prefer to use a clip type battery holder, which can be purchased quite reasonably. (See Parts List for part number.)

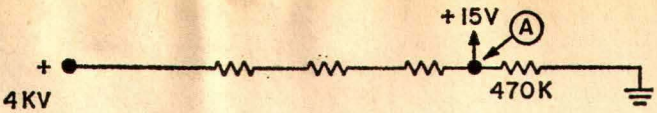


The "innards" of the HI-FET showing location of the various parts. Note perf board mounted on meter.

To speed up completing the project we used a magic marker to change the calibrations on the meter scale. The 0-50 *u*A



Circuit of HI-FET. We used precision resistors, but see text.



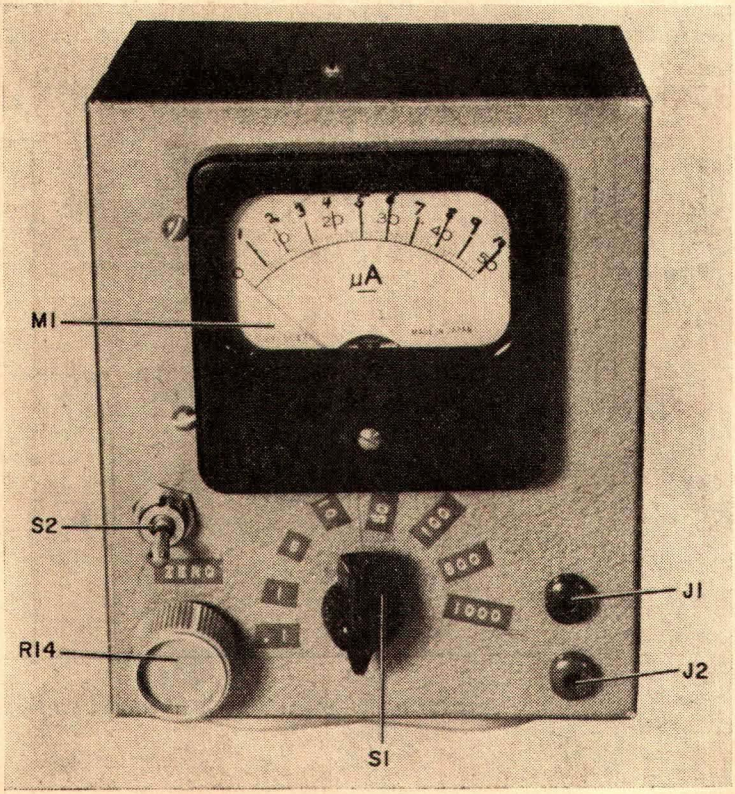
Schematic of voltage divider of oscillator power supply. Note 15v tap at point A (see text).

scale is divided into five major sections, each having ten uniform divisions. We changed the markings to ten major sections each with five divisions. Should you care to make a more professional looking scale may we suggest you refer to the article in the September/October 1969 issue of ELEMENTARY ELECTRONICS, which is titled: *Meter Scales You Can Count On.*

Test Leads. We modified the red probe end of a standard set of test leads to include R1 in the handle of the probe. Unscrew the insulated plastic tubing from the tip of the red test lead. Remove the wire from the tip and solder one end of R1 into the tip. Cut the wire leads of the resistor (R1) to a length that will just permit soldering it solidly in the tip on one end and soldering the wire that was removed from the tip to the other end. Insulate this connection with thin sleeving to protect the joint but still permit the assembly to be freely inserted into the plastic probe handle. Just as a friendly reminder—do not solder the test lead wire to the resistor before making certain that the plastic probe handle that had been unscrewed from the tip to make the modification originally, has been slipped over the wire and is in proper position to be screwed back on to the tip.

Calibrating HI-FET. Before applying battery current to the circuit we suggest that you double check against the schematic diagram your wiring of the unit to be sure that all wiring has been completed and is correct.

First, place R14 in the center of its rotation, then set R12 at minimum (full resistance) and finally set the range switch (S1) to the 10 V position. Now turn on S2 and zero the meter by rotating R14 in either direction until the meter is set on zero. Next connect the probes to a six volt source, known to be exactly six volts, and adjust R12 until the HI-FET reads just six volts on its scale. When you have completed this adjustment you have calibrated all of the ranges of HI-FET, so go ahead and use it for all of your measurements within the scope of its various ranges. You should, however, check its calibration from time to time. ■



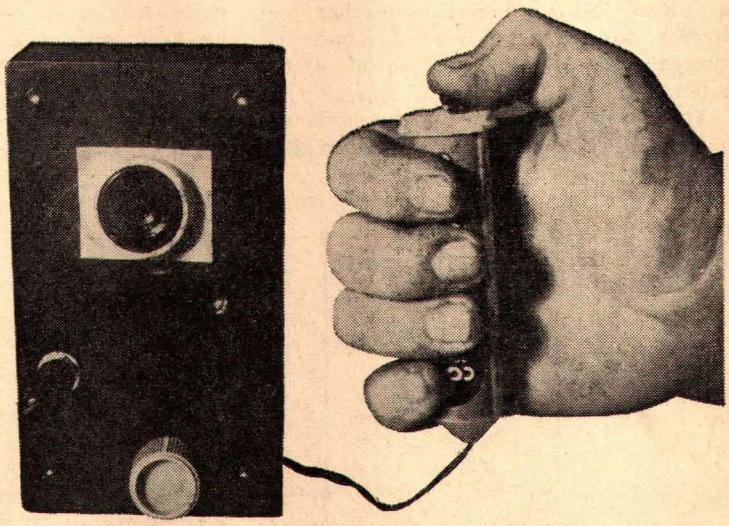
HI-FET panel layout. You may want to use a different method for marking the calibration of the meter (see September/October 1969 Elementary-Electronics-Meter Scales You Can Count On). Also you may want to use a dial plate for S1.

SonoPulse Timer

by Steve Daniels, WB2GIF

WOULDN'T YOU RATHER listen to a dulcet tone when timing a science project, or in the darkroom timing exposures and/or development, or when timing sports events, or any timing you may require, rather than to have to use a stop-watch? You can, you

Use our beeping timer in timing your darkroom or sports events and check the text for a test of your understanding of electronic circuits!



know, by building an electronic timer, and you can build our SonoPulse timer for about $12.00.

Why bother, you say. Well, for one thing, think of the pleasure and experience you will have building this intriguing solid state device; for another, particularly when in the darkroom, you are not forced to strain your eyes concentrating on the face of a dimly illuminated (safe light) clock. And, if you use a foot switch to trigger the SonoPulse, both hands will be free to perform other necessary functions during the timing process.

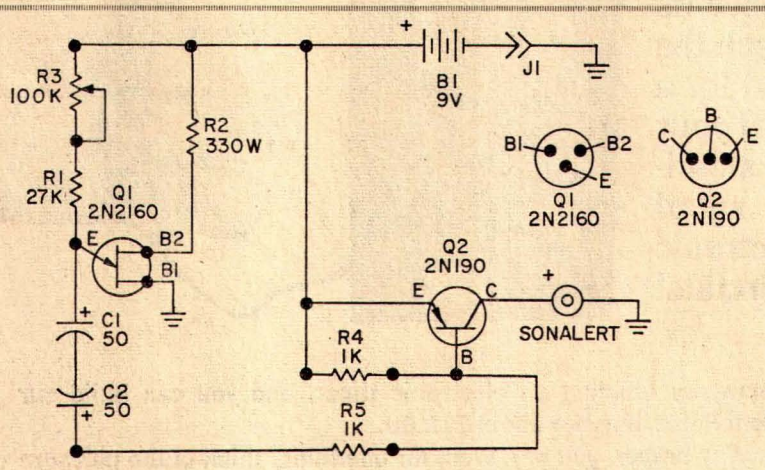
The SonoPulse employs one unijunction transistor (UJT) and one *pnp* general purpose transistor, plus five resistors, two electrolytics, a 9-v transistor radio battery, and an interesting new solid state miniature audible-signal device that emits a pleasant beep tone, develops a husky signal (approx. 50-80 dB). Although the audible signal unit draws just a couple of mA, it's all

housed in a neat 6 x 3½ x 2-in. plastic instrument case. The timing pulses can be varied from one every ¾ of a second to 3.5 pulses per second.

How It Works. The UJT (Q1) is connected as a conventional relaxation oscillator wherein C1 and C2 charge—but wait a minute—how can these capacitors be charged when the ends of the series connection are both returned to the positive side of the battery? And if, as stated above, this is a series string of two electrolytic capacitors, each having definite plus and minus connections, how do you account for the two negative leads being connected together and floating, with each positive lead connected through resistors to the positive side of the battery?

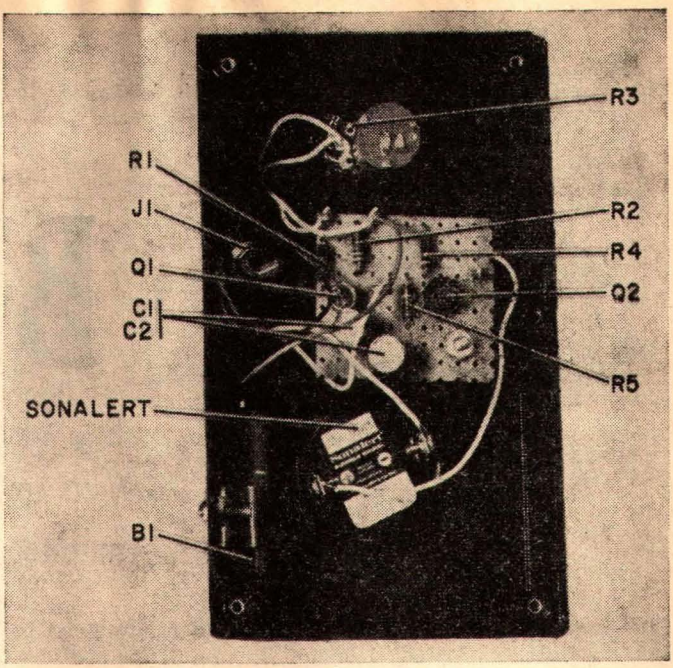
The prime reason this manuscript was published by the Editors was the open challenge the schematic diagram presented to those who wish to find out how the circuit works. Take a good look at the schematic diagram and tell us honestly that you know how the circuit operates. If your answer is affirmative, then dollars to doughnuts you are either a genius or you're just fooling yourself. Before you read on any further, the Editors suggest that you copy the diagram onto a piece of paper and sit down with others who understand schematic diagrams and see if you can dope out exactly how this circuit works. You'll be surprised to discover how complicated a simple circuit can be.

Here is a simple explanation of how the capacitors are charged. Since the collector-to-base junction of Q2 is the equivalent of a diode and has diode leakage, the mystery should be solved. What is required to charge these capacitors is a negative reference point, which in this circuit is the collector-to-base junction. When the firing point of the emitter of the UJT (Q1) is reached, C1 and C2 discharge through the UJT and produce a negative pulse at the base of Q2, causing it



PARTS LIST FOR SONOPULSE

B1 9-V transistor radio battery (Eveready 216 or equiv.)
C1, C2 50-uF, 16-V electrolytic capacitor (Lafayette 34E85521 or equiv.)
J1 Open circuit phone jack (Lafayette 99E62135 or equiv.)
Q1 GE unijunction transistor type 2N2160
Q2 GE transistor type 2N190
R1 27,000-ohm, ½-watt resistor
R2 330-ohm, ½-watt resistor
R3 100,000-Ohm, linear potentiometer (Lafayette 33E11404 or equiv.)
R4, R5 1000-ohm, ½-watt resistor
S1 Switch, single-pole momentary, normally open, pushbutton (Lafayette 99E62184 or equiv.)
1 6⅜ x 3 3/16 x 1⅞-in. bakelite box with aluminum panel (Lafayette 99E62721 or equiv.)
1 Keystone #203P battery holder
1 Battery connector (Lafayette 99E62879 or equiv.)
1 Mallory "Sonalert" electronic audible signal device (Lafayette 12E74018)
Misc. Bolts, nuts, ½-in. spacer, perf board, flea clips, knob, etc.



The works of our SonoPulse timer. Though layout isn't critical this parts arrangement assists in hooking up the unit. The UJT and the unique audible alarm device help make this compact package a reality.

to conduct. Capacitors C1 and C2 are connected "back-to-back" to produce, in effect, a bipolar capacitor since both open ends of that series connection are positive with respect to ground while idling between charges.

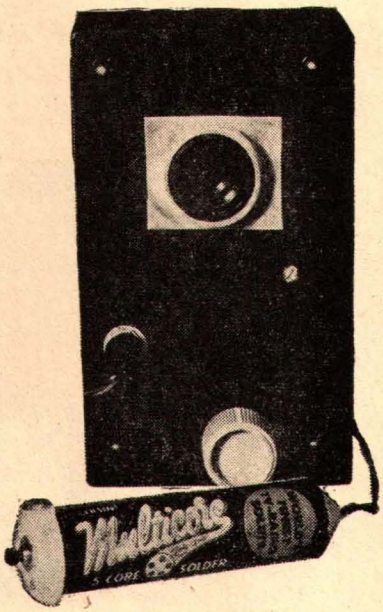
How to Build It. A review of the photos reveals the simplicity of construction. The layout is not critical. We mounted all of the components, with the exception of the audible signal unit, the jack to which switch S1 is connected, and the battery, on a 2 x 2-in. piece of perf board which, in turn, was mounted within the housing by one bolt and ½-in. spacer. The audible unit is mounted in the base of the plastic case, centered in the upper half, by drilling a single 1 3/16-in. hole in the base of the case. You may use a chassis punch, circle cutter or nibbling tool to cut this hole.

The timing control is mounted centered in the lower half of the base and the jack to which the starting switch is plugged for connection to the circuit is mounted on the case wherever it will be most convenient. (Our unit has it mounted in the base near the timing control.) A blank piece of aluminum covers the plastic case and serves as a bottom plate.

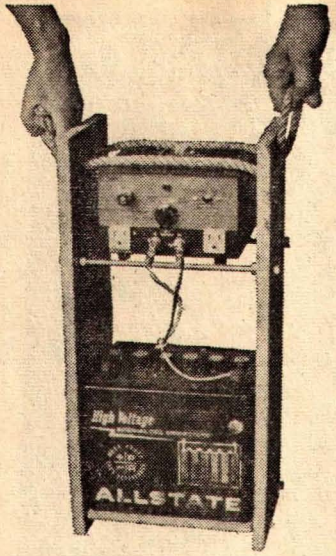
We used flea clips in the perf board as intake-off points for the potentiometer, battery and jack connections. You may want, also, to use flea clips to mount and connect the transistors and other parts, which makes it easier to replace the parts that may become defective. Although we held the battery in place with a simple clip bolted to the side of the plastic case, you may prefer using a battery holder.

As you can see in the photo, we used a miniature pushbutton switch which we mounted in a discarded container from solder for S1. It serves the purpose well. However, should you prefer a foot-operated switch you may improvise one or buy a commercially built foot switch. You can easily make one by mounting the miniature pushbutton switch in a rubber, hollow door wedge (available from hardware or variety stores).

(Continued on page 108)



Operating side of the SonoPulse timer. Note the simplicity of controls that make it easy to use.



BUCKET

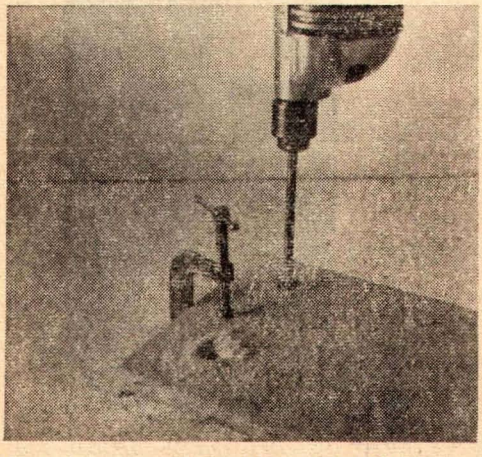
Ever wish you had a Bucket of Volts to power a job that was a mite too far from an outlet?

Anyone that uses electric-powered hand tools needs a Bucket of Volts. Reason is that extension cords can't reach to forever. And anyone that knows how to use those electric-powered hand tools won't find any problems in the construction of the Bucket of Volts we're about to describe. Construction is largely just a packaging job—you simply build a carrier for a 12-V automotive storage battery and wire up a Knight-kit KG-666 Power Inverter/Charger.

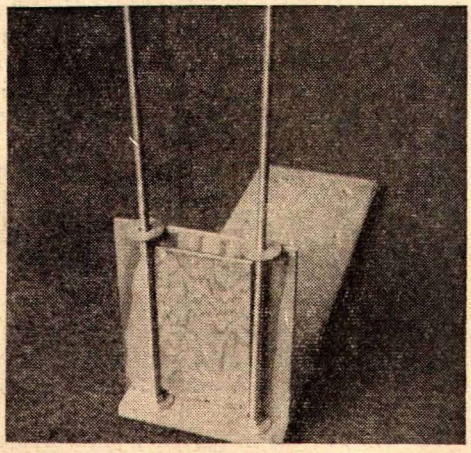
That's all you need—except for a few short cables to connect the battery to the Power Inverter/Charger.

The charger section charges the storage battery when the Inverter/Charger is plugged into a convenient wall outlet. Then the battery provides for the inverter section at some location where a wall outlet isn't handy. It's a lot like filling a bucket with electricity to carry it to wherever you need it. And you won't have to waste half your time fooling with tangled extension cords.

Bonus Extras. For even more convenience, you can add an automotive cigarette lighter socket—about $2.00—to power any of those plug-in accessories designed for passenger cars without even having the car. You'll find many uses for a battery-powered vacuum cleaner around the patio or for a 12-V CB rig or high-powered spotlight when camping or fishing.



First, clamp two ends together and drill 7/16-in. holes for rods, 1/2-in. holes for rope handle.

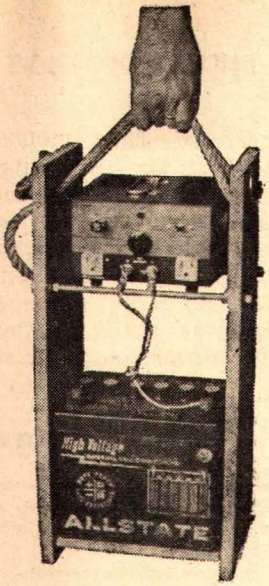


Next, insert threaded rods in bottom holes of one end. Position bottom shelf, insert proper spacer.

OF VOLTS

Here's your answer in a portable powerhouse that goes anywhere.

by Elmer C. Carlson

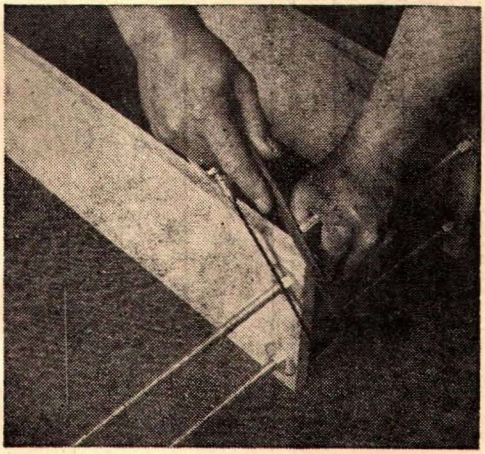


The KG-666 used as an inverter will power just about any small 117-V (AC or DC) appliance—a couple of fluorescent lights, a pair of 75-watt flood lights, a small electric drill, soldering iron, or even an electric typewriter and desk lamp. So why not enjoy a new freedom—take your work, or your hobby, out under the trees and away from those four walls!

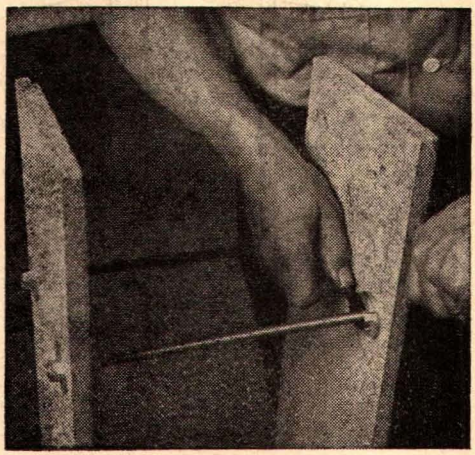
The Circuit. The basic hookup for the Bucket of Volts is shown in our pictorial diagram (see next page). Connections to the battery terminals can be made using replacement cable terminals, available at most automotive parts suppliers.

Connecting cables for the inverter input should be at least AWG-14; AWG-12 or AWG-10 would be even better. If heavy conductor wire isn't handy use two AWG-14 wires in parallel or even three AWG-18 wires.

Since the size of the battery case will vary from that of a small battery used for a compact or small foreign car to the dimensions of the largest-sized lead-acid battery used in the plushiest automatic monster on four wheels, we've left it for you to put your own battery's dimensions into our pictorial diagram. But whatever you do, be sure you pick a high-capacity battery. Don't think you can get power for very long out of one of those small batteries used for motorcycles



With second end in place, hex nuts are thumb-tightened, excess length of rod cut off flush with nut.



When fourth and last rod has been seated, it's time to tighten nuts securely. Two wrenches work best.

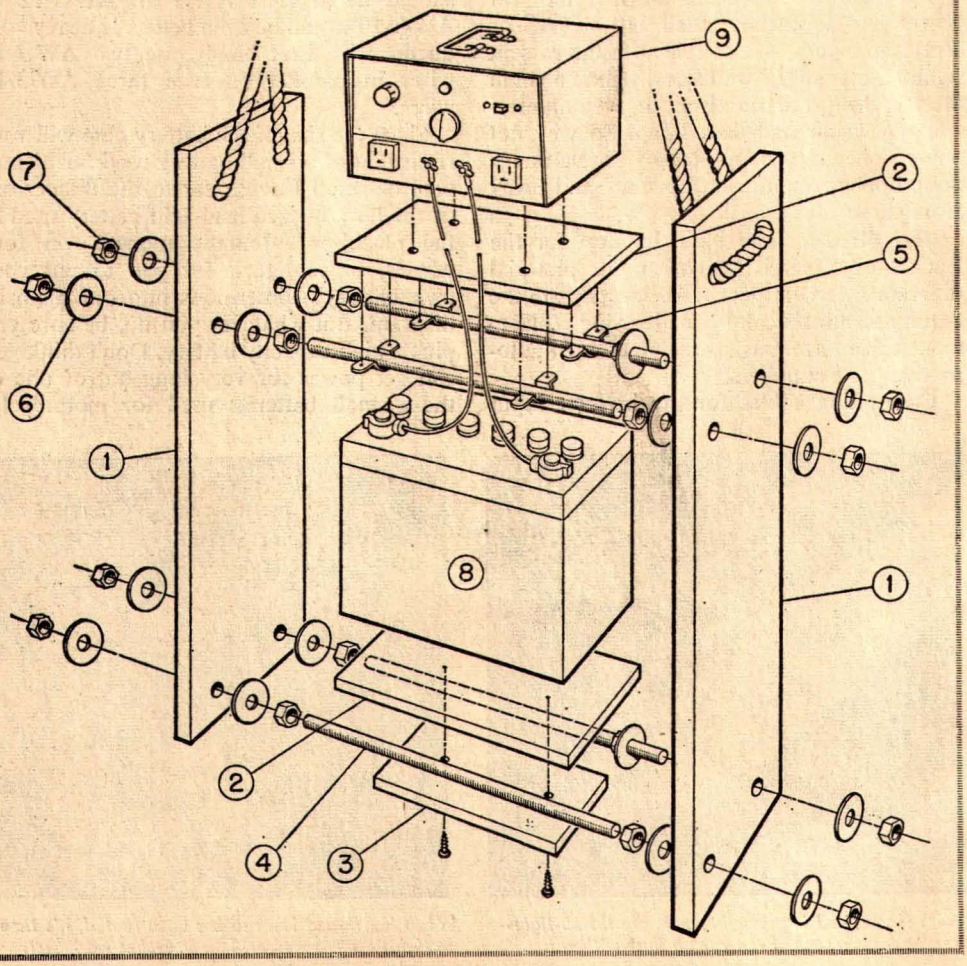
or little sports cars. Think Cadillac!

Battery Buying. Considering the wide variety of truck, tractor, marine, and passenger car batteries, you can choose from better than two dozen sizes and styles. You can either pick up a serviceable battery at a used auto parts dealer or junk yard or go to a discount house or gas station for your battery. No matter where you go be sure to pick a popular size and style. After all, you don't want to put together a new battery carrier every couple of years when you have to replace the storage battery!

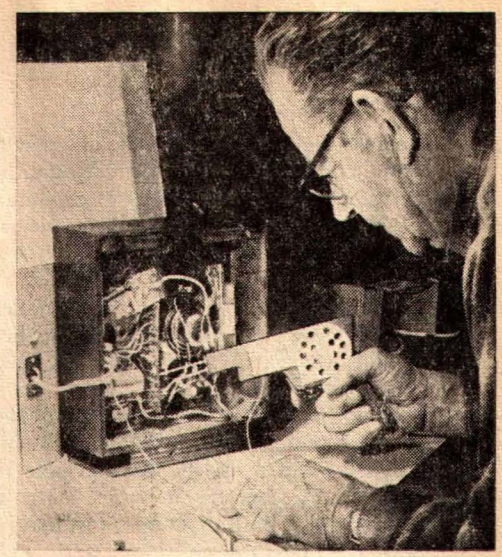
To prolong battery life make sure the battery is always charged and filled with distilled water. While some claim that tap water is satisfactory for batteries, you'll get longer use if you, personally, fill your battery with distilled water. Treat a battery with all possible loving care and you can get four to six years out of a battery with a two-year guarantee. ■

BILL OF MATERIALS FOR BUCKET OF VOLTS

1—¾-in. plywood end (2 required—see text)
2—¾-in. plywood shelf (2 required—see text)
3—¾-in. plywood spacer block (to make unit flush with floor)
4—⅜ x 16 threaded rod (4 required)
5—⅜-in. cable clamps (4 required)
6—⅜-in. flat washers (16 required)
7—⅜-in. hex nuts (16 required)
8—12-V automobile battery
9—Knight-kit KG-666 power inverter/charger (Allied 22 A 3906 X)
Misc.—Battery cables, battery clamps, rope handle, harware, etc.



PISTOL GRIP SIGNAL TRACING GUN



Arm your shop with our signal tracing gun to hunt the culprit in troubled circuits

by Homer Davidson

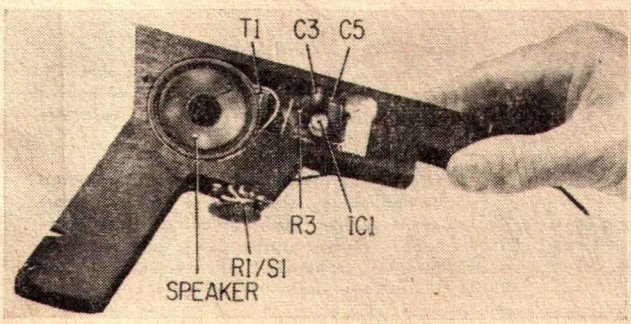
Integrated circuits (ICs) are here to stay. To gain experience in using them, as well as in building special equipment that benefits from their design advantages, why not construct our pistol-grip signal tracer, which uses a single IC? This instrument, though small in size, is big in performance. The unit has many applications in tracing signals through receivers, transmitters, modulators, tape units, etc.

The RCA type CA3020 IC, heart of our signal tracer, is a multi-purpose, low-level wide band amplifier that operates on 3 VDC, easily obtained from two small penlight cells.

Utilitarian Packaging. By building our signal tracer into the form of a hand gun, with separate probes for audio and RF signals, we have a very easy-to-use signal tracer. It will help in troubleshooting electronic circuits by following signal flow through the unit under test from its input to its output. The complete assembly uses several modern construction techniques to package this multifunction signal tracer in its small unique housing. The unit is modularized, having an amplifier module, audible module, and power module.

Two penlight battery cells wired in series comprise the power module to develop the 3 VDC required by the amplifier. The audible module is the 2-in. PM speaker which is mounted within the pistol-type housing. The amplifier module is a printed-circuit assembly containing all of the components for the amplifier except for the switch and volume control.

Be a Gunsmith. The housing for our pistol-grip signal tracer is fashioned from a scrap of ¾-in. plywood, approximately 6 x 7 in., finished on both sides. Before finally shaping it into the form of a pistol, we suggest that you make the necessary cut-outs as shown in Fig. 1, in order that you can leave sufficient plywood around the cut-outs so as not to weaken the finished structure.



Pistol grip tracer's right side cover removed to show location of speaker, the IC, (mounted on its circuit card) and various other components on card.

e/e SIGNAL TRACING GUN

The two plates that cover the main cut-out for the speaker and circuit card can be made from hard board (Masonite) or aluminum. When drilling the speaker grilles, clamp both pieces together so that both will be identical and you will have just one drilling session. When drilling the large holes for the batteries and probes, use a smaller bit to first drill a pilot hole. This will keep the final drilling with the larger bit properly centered and prevent possible splitting of the plywood. Use a 31/64 bit for final hole size in the barrel and a 15/32 bit for the hole in the handle to accept the batteries. Drill a 1/8-in. hole from base of handle through to the cut-out to pass the positive battery lead. Also use the same size hole centered in base of the battery hole to the cut-out to pass the negative battery lead.

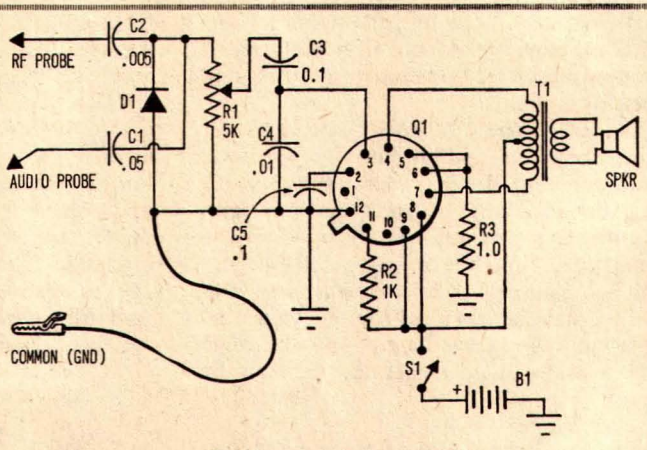
A circle cutter will do the best job in making the speaker opening. However, if one is not available you can make this cut-out with a coping saw.

When all cut-outs and holes have been made and the pistol from has been fashioned, fill any chips, resulting from this work, with plastic wood or wood filler and then sand down the gun body until its surface is smooth. Round off all edges and apply several coats of flat black spray paint. Spray the cover plates flat white or any other contrasting color you may prefer to make your signal tracer look attractive, as well as being a useful piece of test gear.

Probes are made from stiff, heavy wire obtained from an ordinary coat hanger. Cut two straight pieces about 5-in. long and bend a small loop in one end of each piece. Grind or file the opposite ends to sharp tapered points about ½-in. long. Clean the wire loop and the points thoroughly and tin them, using a heavy-duty soldering iron or gun. Bend one of the probes as shown in Fig. 2; this will be used as the audio probe.

Printed Circuit Board. The amplifier module circuitry is made by etching the copper foil of a 2¼ x 1⅛-in. piece of copper-clad perforated phenolic board (details on the etching process will be found on page 32 of the September/October 1969 ELEMENTARY ELECTRONICS). Fig. 3 is a full-scale drawing of the circuit board that can be used as the pattern for applying the resist. Push-in terminals should be used to anchor and connect components mounted on the board.

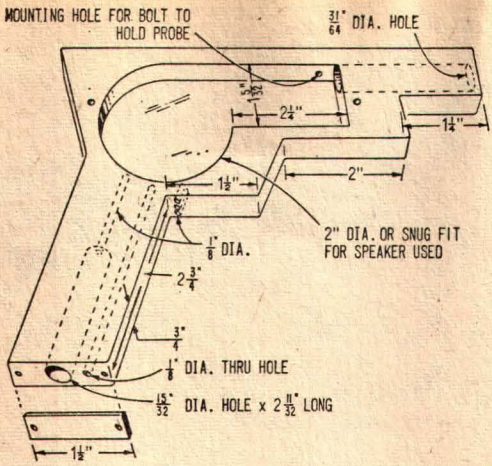
Schematic of signal tracer. Note the difference between the RF and audio inputs. RF input is ahead of diode which serves as detector extracting audio from RF signal, then fed into amplifier at same point as the audio probe.



PARTS LIST FOR PISTOL-GRIP SIGNAL TRACER

B1—3-V battery, 2 Eveready #904 or equivalent cells in series
C1—0.05-uF, 75-V ceramic disc capacitor (Lafayette 99T6068 or equiv.)
C2—0.005-uF, 75-V ceramic disc capacitor (Lafayette 99T6062 or equiv.)
C3, C5—0.1-uF, 75-V ceramic disc capacitor (Lafayette 99T6069 or equiv.)
C4—0.01-uF, 75-V ceramic disc capacitor (Lafayette 99T6063 or equiv.)
Q1—RCA 3020 integrated circuit
R1—5000-ohm, audio taper potentiometer with switch S1 (Lafayette 99T6019 or equiv.)
R2—1000-ohm, ½-watt resistor
R3—1.0-ohm, ½-watt resistor
S1—Spst switch (part of R1)
T1—Output transformer: pri., 125 ohm CT; sec., 8 ohm (Lafayette 33T8571 or equiv.)
1—2-in. speaker, 8-ohm voice coil (Lafayette 99T6036 or equiv.)

Misc.—¾-in. plywood 6 x 10 in.; hardboard or aluminum sheet; wire coat hanger; screws; solder; push-in terminals; GE silicone rubber cement; spray paint; phenolic, perforated, copper-clad on one side, circuit board; hook-up wire; alligator clip; etc.



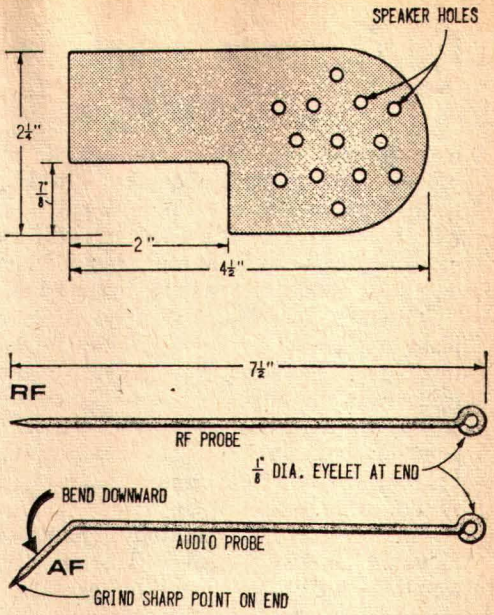


Fig. 1. Gun's main frame in which are mounted the speaker, printed card and batteries. Right above: Cover plates, two needed. Fig. 2. Right, RF and audio probes are of stiff wire.

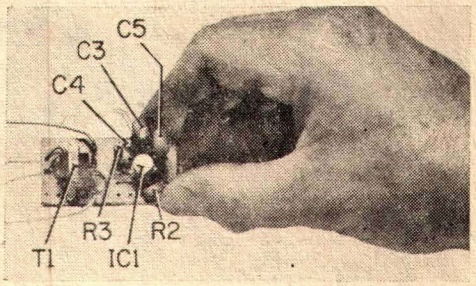
Flow solder around the push-in pins where they make connection with the etched copper circuitry; the locations of the components are detailed in our photos.

Mount all components and double-check to be sure they are correctly located before soldering them to the push-in pins. Though recommended, it isn't absolutely necessary to use push-in pins. Wire leads from the components can be fed through the holes in the perforated board and soldered directly to the copper foil remaining after the etching process. Apply the soldering iron as quickly as possible, since excess heat can destroy bonding of the foil and also, the miniature components, especially the IC. If at all possible, use a small battery clip as a heat sink on each lead when soldering the IC.

If you don't want to go through the etching process to make a printed circuit board, the circuit can be hand-wired to the components in lieu of the copper foil. You would then use unclad perf board. Make all leads between components as direct and as short as possible.

Assembly. First step in assembly is to mount the probes. Solder hook-up wire for connecting leads to the tinned loops on the probes. The straight probe is bolted to the top of the large hole drilled in the barrel. Drill a clearance hole for the bolt, centered in the ¾-in. width of the top of the gun barrel, about 2 in. from the front. Use a 6-32 machine screw just long enough to pass through the plywood and wire loop and to leave enough threads exposed to attach a nut and retaining washer. The bent probe will rest on the bottom of the hole in the barrel.

After positioning it, fill this hole completely with GE silicon rubber sealant which will, when it sets, hold the probe in position



Printed circuit card with all identified. When circuit checked out cement in main frame.

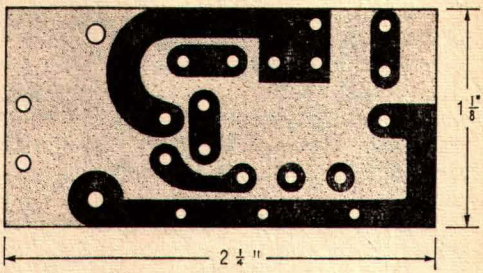


Fig. 3. Exact size printed card layout. Trace lines on copper faced side for etching circuit.

and separate and insulate it from the top probe. Solder the series connection between the batteries as well as the positive and negative leads before inserting the batteries and screwing down the bottom plate of the handle. Next, mount the batteries in the handle.

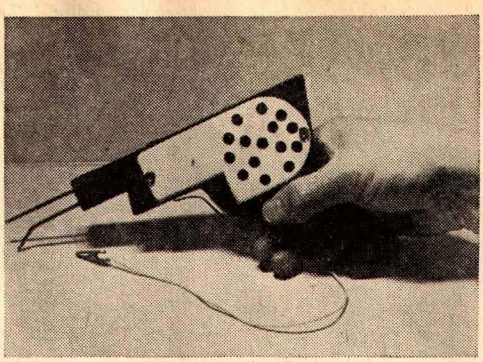
This done, fasten one of the side cover plates to the body in its proper position with small wood screws. Drop the speaker into place from the opposite side of the cut-out so that front of speaker rests on the cover plate. Spot several drops of the silicon rubber sealant around the circumference of the speaker to hold it in place.

The switch and sensitivity control is mounted on the bottom surface of what would be the trigger guard if this were a weapon. It is held in position by two small wood screws passed through solder lugs of the volume control and screwed into the wood. Use either several washers or nuts, as spacers, to keep from distorting the shape of the soldering plugs. Connecting wires to the switch and the control are fed to the amplifier cut-out through ⅛-in. holes drilled into the housing adjacent to the connecting points on the switch and control.

Solder the diode and input capacitor to the leads from the probes and lay them on the bottom of the cut-out. Be sure diode is polarized as shown in the schematic.

Now mount the circuit card in the opening provided for it. Place the card tightly against the speaker magnet and use the silicon sealant to cement it in position. Solder all leads from the batteries, the probes, the switch and sensitivity control and a flexible lead about 12-in. long with an alligator clip on its free end, to be used as the ground lead, to their respective connecting points. It will be wise to make a preliminary check of the amplifier before fastening it in position with the sealant. To do this, connect the batteries and turn *on* the switch. Set the sensitivity control nearly full *on,* and touch one of the probes; a humming sound in the speaker will indicate the amplifier is working.

Final Test. Now that you have completed all of the construction (except for installing the final cover over the cut-out) you're ready for the crucial moment. Will the tracer work? But of course it will—you made a preliminary test before applying sealant to hold the circuit card in its cut-out.

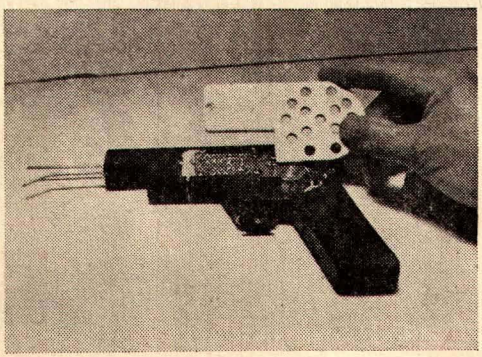


This is how your completed gun will look. The contrasting color cover plate is attractive.

Turn *on* the switch and set the sensitivity control to maximum. You should hear a fairly loud hum whenever you touch either probe. Another check is to hold either a soldering iron that is connected to the power line, or a soldering gun near the probes but not touching them. A loud induced hum should be heard. Changing the setting of the sensitivity control should vary the loudness of the hum. Minimum volume should be just after the switch is turned *on,* maximum should be at full-on rotation. If your tracer reacts just the opposite of this, reverse the two outer connections to the control.

If no hum is heard, either in the preliminary or the final test, first check battery polarity, battery voltage, and current drain. A 0 to 50-mA milliammeter connected in series with either battery lead (observe correct polarity) should read 18 mA with the

(Continued on page 107)



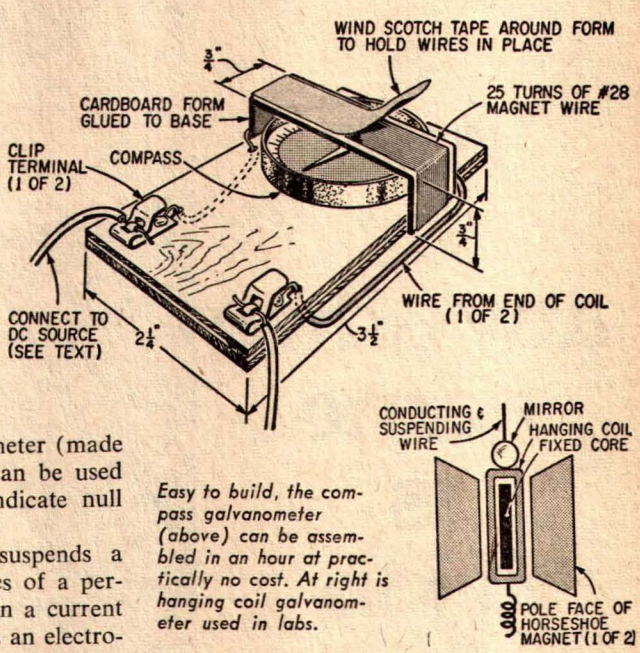
Left side of gun with cover plate removed showing underside of printed circuit card.

COMPASS GALVANOMETER

by T. A. BLANCHARD

Many electrical measuring instruments today are based on the design of the d'Arsonval *String Galvanometer,* but substitute a needle-suspended coil riding on jeweled bearings for the hanging coil employed in the original precise lab instrument.

The galvanometer is not often used to measure quantity of current flowing in a circuit, but rather to indicate the polarity and presence of small currents by comparison to null methods. The compass galvanometer (made from the illustration at right) can be used with a Wheatstone bridge to indicate null points.



Easy to build, the compass galvanometer (above) can be assembled in an hour at practically no cost. At right is hanging coil galvanometer used in labs.

The d'Arsonval instrument suspends a small coil between the pole faces of a permanent *horseshoe* magnet. When a current flows through the coil it becomes an electromagnet and its *like* poles repel the *like* poles of the horseshoe magnet, thus causing the coil to turn on the connecting wire. The strength of the current through the coil determines the extent of the coil's rotation.

A small pointer attached to the moving coil registers on a curved dial, or a tiny mirror is attached to the galvanometer string. A beam of light is aimed at the mirror, bouncing the beam off to a wall screen or chart to give great magnification of tiny current changes in a darkened room.

Making A Simple Galvanometer. A small amount of insulated magnet wire, any Boy Scout pocket compass and a 2¼ x 3½-in. scrap of plywood is what you need to make the compass galvanometer. Cut a strip of cardboard ¾-in. wide and 3¾-in. long. Score the cardboard ¾ in. from each end, with a dull knife blade and crease so the cardboard form resembles a C or bridge shape. Now glue the cardboard to the edges of the wood base. Do not use tacks!

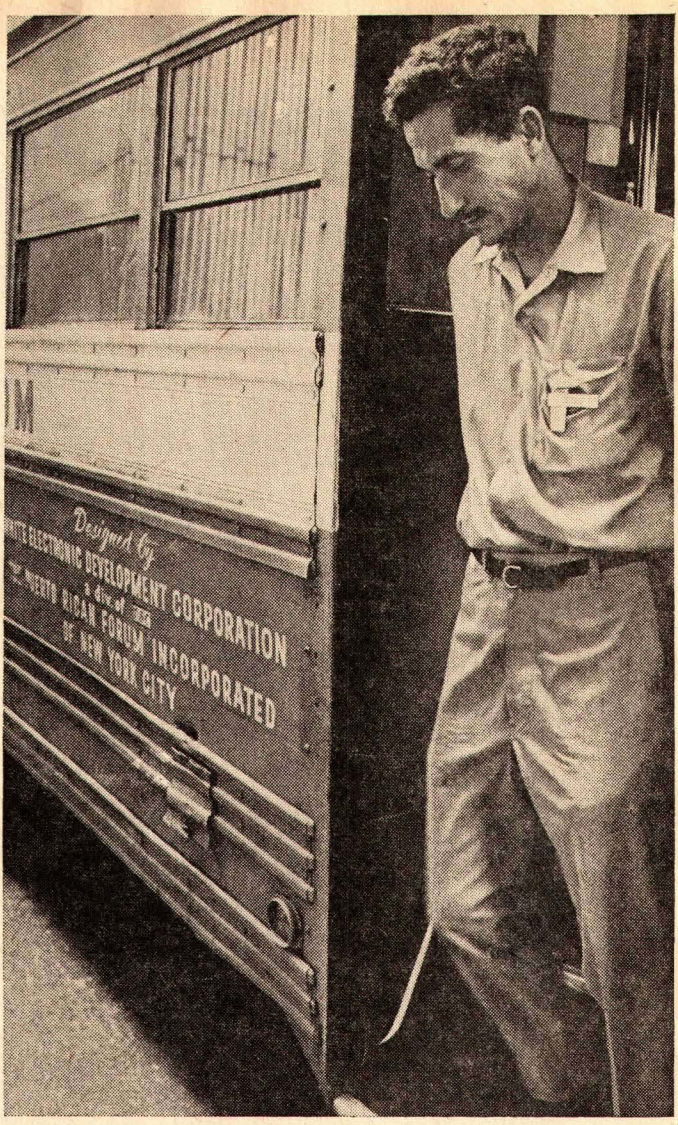
Bind the cardboard with a rubber band until glue or cement dries. Wind 25 turns of #28 magnet wire around the cardboard. Heavier wire and fewer turns will work, too, with a slight drop-off in sensitivity.

Scotch tape is wound around the finished coil to keep the wire turns in place. Connect the ends of the coil to screw terminals or clips. Slip the compass under the coil in a position where its needle comes under the coil and parallel to the coil turns.

Connect the galvanometer in series with a flashlight battery and bulb, a buzzer or a toy motor, etc. When the circuit is closed, the compass needle will be drawn so that it is at right angles to the coil. A slow swing of the needle indicates the circuit is drawing little current. A rapid swing denotes an increase in current flow.

To show how sensitive this simple galvanometer is, connect what appears to be a dead flashlight cell across the terminals, immediately breaking the circuit. The compass needle will spin at a merry clip, indicating there is still some life in the "dead" cell. ■

Student leaves language lab where he has put in many hours in his new language—English. Mobile classroom can go most anywhere.

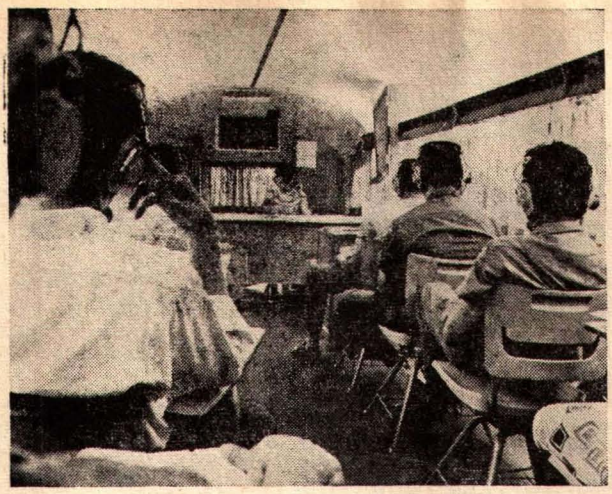


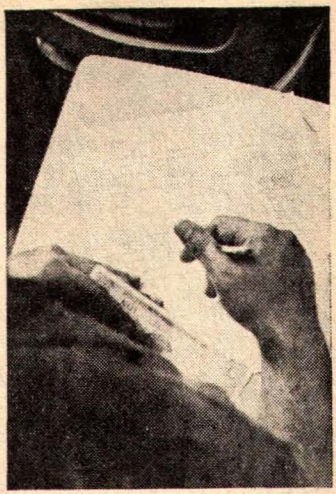
a rose by any other name is a job for SUPER VAN

It's difficult to travel in a place where you don't speak the language, but trying to make a living under such circumstances poses one whale of a problem. In New York City, attempts to leap over the language barrier are being made by a new organization called BOLT.

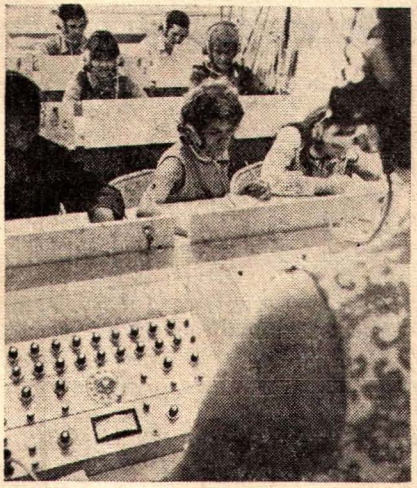
Funded by the Department of Labor, and operating as a project of the Puerto Rican Forum (a nonprofit community-oriented service), BOLT (for Basic Occupational Language Training) teaches job English to Spanish speakers employed in banks, hospitals, housing authorities, and other organizations in metropolitan New York.

Directed by Miss Anna C. Zentella and programmed by Mr. Antonio Martinez, BOLT has been mobilized into a modern language-teaching unit and





Above, left, instructor inside van monitors tape that is used in her teaching. Thanks to all-electronic hookup, she can speak to students individually or collectively at will. Above, right, student takes one of several tests during course to determine progress. Below, left, students sit through taped English comprehension test to gauge qualifications for course. Below, right, young student ponders question as it is heard over earphones. Below, bottom, instructor explains test sheet to student.



travels to various businesses to carry out its teaching program. It is equipped with the latest electronic teaching machines and bi-lingual instructors. With an employer's consent, the mobile unit will teach about 15 employees at each job site for a six-week period in 50 hours of English. Alternatively, it will teach 100 hours of instruction for a twelve-week period.

Some of the research studies that have been made by BOLT after the courses have been given indicate that the student-workers of varying ages and educational levels have improved their English skills—even within a relatively short training period. And perhaps of greater interest to the employer is that the increased ability of the worker to communicate gave him a better job motivation and also increased his loyalty to the organization he was working for. ■

DXing the Spanish Main

by Don Jensen

Vera Cruz, Maracaibo, Cap Haitien, and Kingston are just a few of the exotic

For nearly two centuries, from the early 1500s, the coastal crescent that curves from the Orinoco to the Yucatan peninsula was the richest spot on earth. This was the fabulous, fabled Spanish Main, where the New World's treasure was stored awaiting galleons to carry it to the Court of Castile.

Here were the fortified cities of Cartagena de Indias, Portobelo, Panama, and Vera Cruz. In the waters that washed its shores sailed the bullion ships and merchantmen.

Attracted by the glitter were plunderers, pirates and privateers, sea dogs and buccaneers. From bases on the Mosquito Coast and hidden Caribbean coves they came: Drake, Hawkins, Calico Jack Rackham, Red Legs Greaves, and the blackbearded man called Teach. They sailed forth, sacking cities, seizing ships, and stealing millions—perhaps billions—in gold, silver, pearls, and gems.

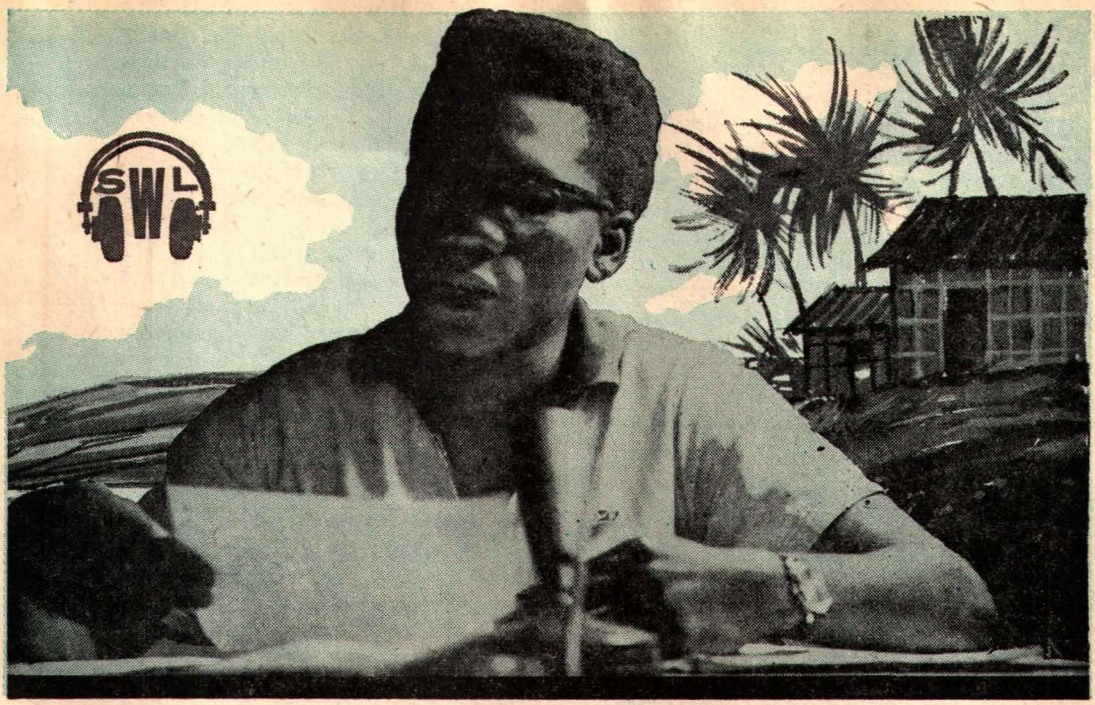
The age of piracy ended in the late 17th Century as the wealth dwindled. Now the only gold along the Main is that of sun and sand. But for listeners there's still a treasure of DX to be found in the lands from Venezuela to Mexico, and in the pirate islands.

Cartagena On BCB. Queen of the Indies was Cartagena. Five times in two hundred years the fortress city was conquered. To Sir Francis Drake, whose black sails entered the broad bay on Ash Wednesday, 1586, the royal coffers yielded thousands upon thousands of silver pesos. Today, its population almost half a million, Cartagena blends the new and old; a busy modern port an industrial city spills out beyond its still standing colonial walls. Oddly enough, considering its size, Cartagena has no shortwave broadcasting stations. But there are five medium-wave outlets.

During the late evenings, DXers can hear HJAE, *Emisoras Fuentes,* a 10-kW station on 922 kHz. The split frequency—between regular U.S. channels—makes reception a bit easier, though careful tuning is a must. HJAE is part of the Colombian Todelar network and, unlike many Latin Americans, is on all night.

For those who "read" CW, there's coastal radio station HKA on 8666 kHz. This one handles shipping traffic in the Caribbean. You may hear it calling CQ around 0530 GMT.

Panama And Mexico. Northward along the coast is the Isthmus of Panama. Here were the towns of Nombre de Dios and Portobelo, where great trade fairs were held each year when the Spanish fleets called. Here, too, is Panama City, which Sir Henry



cities whose names rang through the beards of pirates and radio announcers!

Morgan and his 1400 cutthroats looted for a million and a half pesos in 1671.

Though two shortwave stations are listed for Panama City, and an American naval officer passing through the Canal recently reported them active, it's been several years since they were heard Stateside. Best bet these days is HOU31, *La Voz del Baru,* in the west Panama cattle town of David. It's being heard on 6045 kHz. around 1030 GMT. If sacking is in your bag, forget it—early-morning listening is a must! But Panamanians are rare and this one is worth losing a little shuteye for.

By the way, though much younger than Panama City, David—pronounced dah-VEED—is not without pirate links. It, and a nearby river, are named for one Captain David, an English buccaneer who raided the area in 1685.

While Cartagena and the Panamanian towns handled the wealth of the Americas, through Vera Cruz passed the oriental riches. Each year the Manila plate ship crossed the South Sea to anchor at Acapulco. Well-guarded mule trains carried its contents across Mexico on *El Camino Real,* the royal road. Joined by others from the silver mines of the interior, the trains finally plodded into Vera Cruz. In the fall, ships came to carry the treasure back to Spain.

In 1568, the Englishman John Hawkins, and his younger cousin, Drake, set their sights on Vera Cruz. But an August hurricane and a Spanish defense wrecked the fleet and their hopes.

DX TREASURE CHART

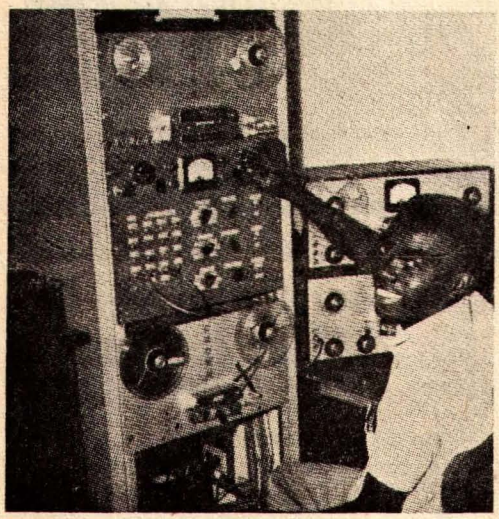
kHz.	Station	Location
770	R. Jamaica & Rediffusion	Kingston, Jamaica
922	HJAE, Emisoras Fuentes	Cartagena, Colombia
4860	YVQE, R. Maracaibo	Maracaibo, Venezuela
5945	YNRG, R. Zelaya	Bluefields, Nicaragua
5955	TIQ, R. Casino	Limon, Costa Rica
6020	XEUW, Eco de Sotovento	Vera Cruz, Mexico
6045	HOU31, La Voz del Baru	David, Panama
6105	XEQM, Sistima R. Yucatan	Merida, Mexico
8666	HKA, Coastal R.	Cartagena, Colombia
9580	YNTP, R. Mar	Puerto Cabezas, Nicaragua
9770	4VEH, Evangelical V. of W.I.	Cap Haitien, Haiti
11835	4VEH, Evangelical V. of W.I.	Cap Haitien, Haiti
11875	Radiodif. Nac. de Nicaragua	Managua, Nicaragua

Except as noted in text, evening hours will provide best reception.

e/e SPANISH MAIN

DXers tuning for Vera Cruz will find XEUW, *Eco de Sotovento* on 6020 kHz. during the evening. Another Mexican city well known to the freebooters is Merida, Yucatan. Its XEQM, *Sistema R. Yucatan,* is frequently heard on 6105 kHz.

Haiti And Jamaica. Piracy, it is said, really began on Tortuga, an island just across a narrow strait from the present-day city of Port de Paix, Haiti. Buccaneer, in fact, is a corruption of the French word *boucanier.* A *boucan* was an open fire pit over which French colonists cured cattle hides before



Engineer's eye view of the control room at 4VEH, Evangelical Voice of the West Indies in Cap Haitien, Haiti. Best heard during the evening hours on 9770 and 11835 kHz.

they discovered piracy paid a far better price in gold!

Port de Paix is a dingy Haitian town of about 6000 persons. Unfortunately, its sole shortwave station, *R. Capois la Mort* has been out of service since 1967. And when it will return to the air is anyone's guess.

Not far away, at Cap Haitien, is one of the best known SWBC stations in the area, 4VEH, the Evangelistic Voice of the West Indies. This friendly missionary station is about as far as you can get from the spirit of Jolly Roger. If you haven't heard it already, tune their Listeners' Post program at 0300 GMT, Saturdays (Remember that's 10 p.m. EST, Fridays).

But the wickedest pirate lair of them all was Port Royal. It was to this corrupt town on Jamaica's south coast that the looters returned to swill rum and toss away their ill-gotten gold in squalid fleshpots. But in 1692, an earthquake—God's retribution, some said—caused the city to sink into the sea. A few miles away, at the north end of the excellent land-locked harbor, Kingston grew up.

Today, Kingston, capital of Jamaica, is a major city and home of Radio Jamaica and Rediffusion. Of its several medium wave frequencies, U.S. listeners most commonly hear 770 kHz. In addition to its broadcasting stations, RJR operates a wired program —*rediffusion*—service. But since these programs are carried by landlines to Jamaican homes, you'll have to concentrate your efforts on the radio outlets.

Pirate Town! What happened to the pirates who scourged the Spanish Main? Many died in battle or fell victim to disease and drink. Others died in Spanish inquisitorial chambers or at the end of a length of English hemp. But some just quietly slipped away to peaceful retirement along the uninhabited Mosquito Coast of Central America.

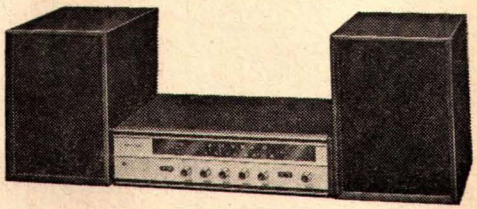
There they established settlements, which ultimately, as in the case of British Honduras, gave a distinctly non-Latin flavor to parts of the region. Perhaps the most interesting of these, now part of Nicaragua, is the city of Bluefields.

Until quite recently, Bluefields was virtually cut off from the Nicaraguan government in Managua. Its language, culture and way of life are more like those of Jamaica than of Spanish-speaking Central America. Its now largely mulatto population, mostly seafarers still, are anglophiles with close emotional ties to the Crown—strange when you consider the Crown colonies during the past 20 years.

Therefore it isn't surprising that Bluefield's *R. Zelaya,* on a frequency that has been varying around 5945 kHz., has occasional English programs and announcements in addition to its Spanish programs. It also helps account for the fact that *R. Zelaya* is friendlier than the typical Latin American station to SWLs who write their reception reports in English. Usually in fact, it replies with a QSL letter, a practice that very few stations care to follow.

Yes, these stations and others like them prove that there still is plenty of treasure for DXers along the Spanish Main. ■

REALISTIC MODULAIRE 12-1471
Solid-State AM/FM-Stereo Component Receiver System



☐ If you're in the market for one of the so-called "Portable Stereo Players" the Radio Shack Modulaire Stereo System—which is competitively priced with the portable players—may be a far better choice.

The Modulaire system consists of an AM/FM-stereo receiver and two matching acoustic suspension speakers, each having a walnut finished wood cabinet. In terms of performance, particularly power output, the Modulaire is, essentially, a portable system. What it has going for it are better quality speakers, and styling that blends with most any decorating scheme.

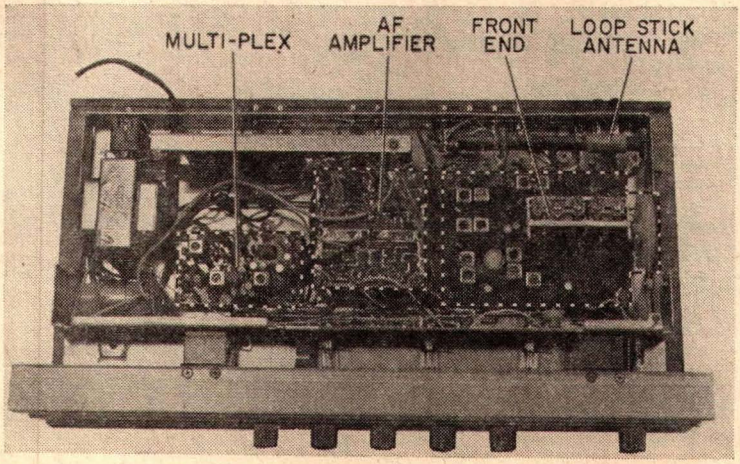
The receiver has inputs for either a high level phono pickup (ceramic type) or a tape recorder. Phono jack outputs are provided for connecting the stereo speakers and a tape recorder. A stereo phone jack is also provided, as well as terminals for an FM antenna. An external AM antenna terminal is provided in addition to the built-in AM loopstick antenna.

Front panel controls are: volume, balance, bass, treble, selector, and tuning. The AC power and AFC switches are also on the front panel.

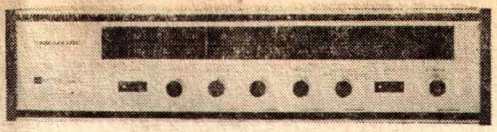
The system is supplied with pre-wired speaker cables which ensure that speakers are correctly phased when connected by these cables.

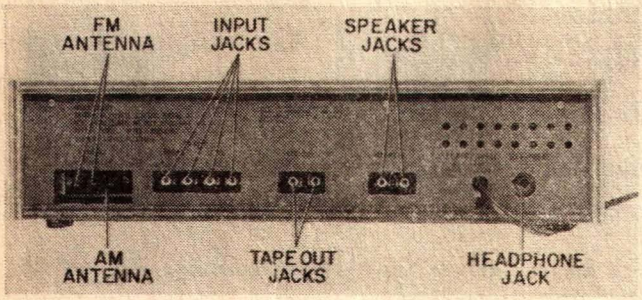
The receiver is modularized, with separate printed circuit modules for the front end, IF strip, audio, power supply, etc. This results in a very compact unit measuring just 16½ x 4 x 8½-in. (WHD). The matching speakers, which normally are positioned on either side of the receiver, can be easily placed in any location by simply adding to the supplied speaker wires. Each speaker is 8x10¾x8½-in. (WHD).

Performance. Measured power output per channel for less than 1% THD (total harmonic distortion) was 3 watts rms. While this is low by hi-fi standards, it is competitive with portable systems, and combined with the relatively high efficiency speakers the 3 watts delivers a substantial sound output level. As shown by our frequency response curves, the amplifier is reasonably



Bottom view shows modular construction with separate printed boards for each functional circuit. Front end, IF amplifiers, AF amplifiers, power supply, and multiplex circuits are each built complete on a separate printed board and interconnected with wiring harness.





Above, front view of control center of Realistic Modulaire system. Long dial makes for easy tuning; convenient location of all other controls helps to simplify overall operation.

Left, a rear view of control center, showing jacks for connecting antennas, auxiliary inputs, recorder, speakers, and a pair of headphones.

flat with the tone controls centered. The tone controls provide equalization from a modest to broad range depending on the frequency. Signal-to-noise ratio is better than 70 dB, with no apparent hum at any volume control setting.

The FM sensitivity measured 5 *u*V (IHF), with full noise suppression at 15 *u*V. The FM frequency response was essentially flat. Typical of many budget stereo systems, the FM-stereo mode had a noticeable hiss with moderate to weak signals which could be eliminated by switching to the mono mode. A full time indicator lamp shows which stations are broadcasting in stereo. Stereo separation, by the way, measured 27 dB at mid-frequencies.

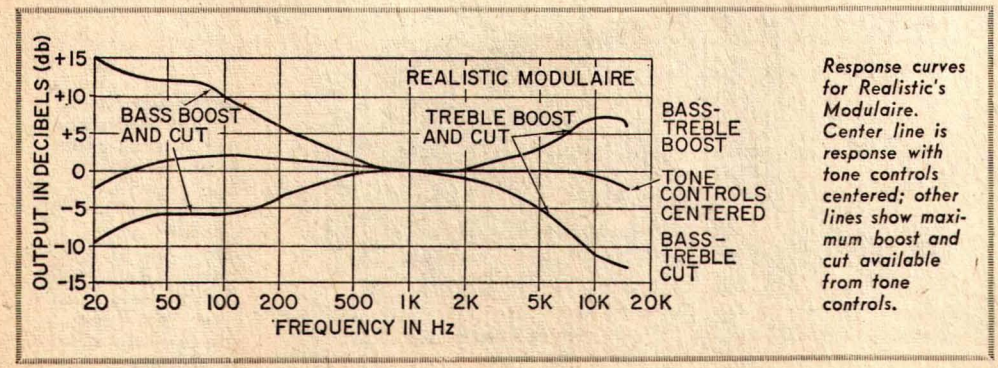
The AM performance was adequate, which is typical of most AM receivers available today. AM noise suppression was average, which means "hash" from fluorescent lights and universal motors was unnoticed on all but the weakest stations.

The Radio Shack Modulaire system, complete with speakers, is priced at $99.95. A matching record changer and base, which fits on top of the receiver, is available. A package consisting of the Modulaire system, the changer and a changer cover is priced at $129.95.

Though it isn't evident from our photos, the speakers supplied with the Modulaire system will fit flush, side-by-side, on top of the receiver. Naturally, no one in their right mind would want to listen to stereo with the speakers positioned in this fashion, but this precise fit does suggest some of the thought and planning that went into the design of the Modulaire. The system is a natural for bookshelf or table.

Summing up. The Radio Shack Modulaire system provides a performance level equal to or exceeding that of the average "portable stereo player". Competitively priced with portable one-piece players, it makes a good "second system". The wood cabinets and styling assures that the Modulaire system readily blends into any decorating scheme.

For additional information write to Radio Shack, Dept. D., 730 Commonwealth Ave., Boston, Mass. 02215. ■

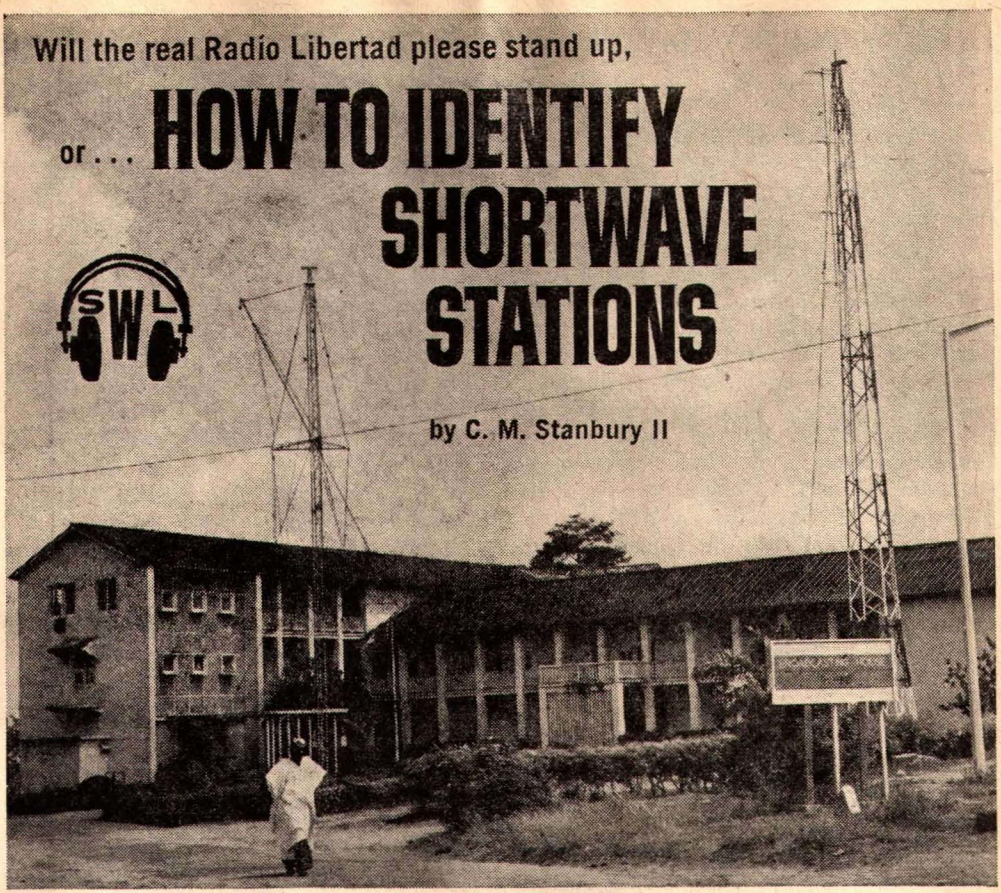


Response curves for Realistic's Modulaire. Center line is response with tone controls centered; other lines show maximum boost and cut available from tone controls.

Will the real Radio Libertad please stand up,

or . . . HOW TO IDENTIFY SHORTWAVE STATIONS

by C. M. Stanbury II



In the event you haven't noticed, DX these days is a pretty rough sport. Of course, it always was (despite those occasional bits of nostalgia about the "good old days when DXers just DXed"). Today, it seems that almost every distant radio listener wants to be the one and *only* "DXpert." All of which means that anytime you report hearing a station that even approaches the rare or controversial, you'd better be dead certain of your ID.

Make no mistake about it—accurate identification is the distant radio listener's Number One Problem. One obvious reason is that many of the more interesting stations don't broadcast in English. Then, too, the most important loggings are often made under the worst of conditions: weak signals, high noise levels, and severe interference from other stations. Under these circumstances, even English language voices can be difficult to positively identify.

Common Methods. If reception conditions are good, a foreign language isn't nearly the problem it seems at first. Such controversial locations as Cairo, Havana, Moscow, Peking, or Tirana (which aspiring DX gurus are continually investigating) sound more or less the same in any language. Simply listen for the interval or tuning signal (bells, chimes, a few musical notes repeated over and over, etc.) and then catch the location. Once you've done this, the interval signal itself will help you ID the station when you hear it again.

Another good approach with the large international SWBC operations is to pick up a station while it is broadcasting in English, then stay tuned while it transmits in other languages. You'll thus become familiar with this organization's ID announcements in various tongues.

When identifying Latin Amercan targets, you often must try to pick up both the location and station name. Not only do many stations operate from the same city, but it's not uncommon for several stations at different locations to use the same name. For example, there are at least three R. Libertads regularly heard in North America—

at Baranquilla, Colombia (600 kHz); Managua, Nicaragua (885 kHz); and the clandestine "La Voz Anticommunista de America."

Of course knowing in advance who is transmitting on the frequency at what time and in which language can be extremely helpful, especially on Medium Wave where many receivers are much better calibrated. However, stations often switch frequencies and schedules so it isn't a good idea to base your ID on advance information alone, particularly if there's anything controversial about the transmitter or your logging of it.

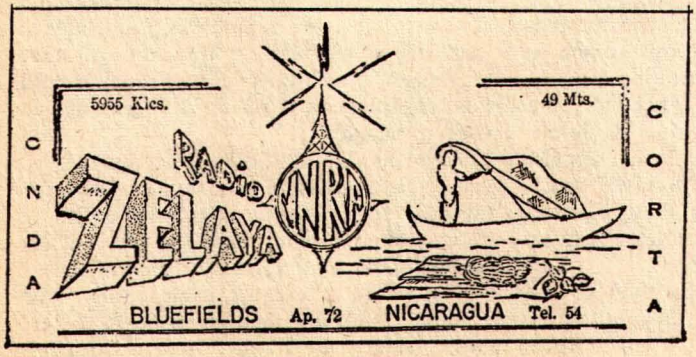
The Best Method. Obviously, the more controversial the station, the more sure your ID must be. A good example of this is provided by my own logging of BBC Francistown (Botswana) twice in the spring of '68 on 647 kHz Medium Wave. For better or worse, another DXer claimed that our reception was impossible because it contradicted his own propagational theories.

While no other station known to operate on 647 kHz fit the description of what we'd heard, the only way to defend our honor as No. 1 DX guru was to find a BBC official who *could* and *would* check out the details of our reception. It should be noted that a disturbing number of SWBC stations "verify" DX reports automatically, i.e., they issue QSLs without ever bothering to check reception details.

But as luck would have it, BBC Ascension took over the duties of BBC Francistown and on the Ascension Island staff was a radio man who did carefully look over reports and freely rejected those of a dubious nature. Only a few months earlier he had written one radio club that "I am being besieged with reception reports . . . most of them wrong!" Clearly here was someone who bothered to check what he verified. We therefore reported, in part, as follows:

"It is my understanding that your S. Atlantic relay has now replaced the Francistown facility. . . . I tentatively logged BBC Francistown 20 Feb. at 0358 (GMT) S/On. I have seen this time reported in several other SW bulletins as '0355 bow bells & S/On', but I believe the actual S/On announcement is at 0358. Then at 0400 low pitched A2 jamming became audible on the frequency. Exactly the same type as used by Rhodesia on 4845 (neither square wave nor buzz saw). On March 11 I heard what may have been the same

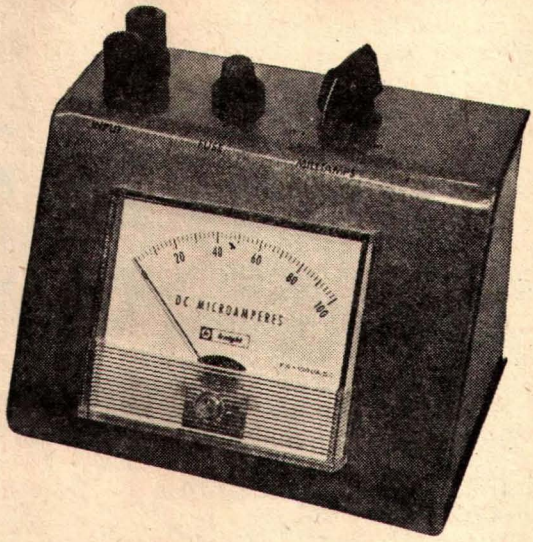
(Continued on page 107)



Typical QSL cards and a letter the author has received in his quest for positive identification of stations he has logged. Many stations send cards without first checking the request from listeners for validity of reception. Much confusion exists due to similarity of call letters and because of language difficulties. Take every step to confirm your reception before claiming to have received the station.

the third hand

Don't get caught short handed and wreck your solid-state project.

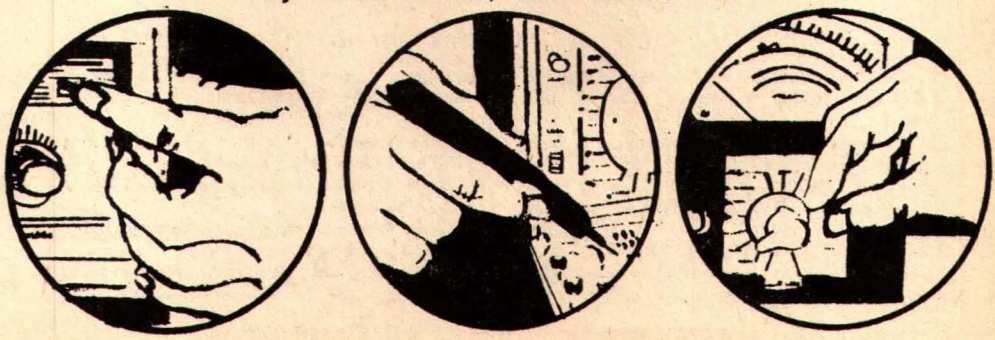


How many times have you wished you had a third hand? Show us typical experimenters and we'll show you eager candidates for that third hand, particularly when they are in the process of making tests on a new solid-state project. After all, one hand is needed to hold the test probe on the test point, and a second is needed to operate the range switch on the test meter in a hurry, particularly if maximum potential ranges aren't known, and a quick change is needed to avoid blowing the meter to kingdom come. Well what's the third hand for? To turn off the power in a hurry, hopefully before a transistor or diode is completely destroyed.

How It Functions. It is a known fact that transistors and diodes usually are destroyed in less time than it takes the average type of fuse to blow, even though sized properly for the load, or, in the time it takes a technician or experimenter to pull the plug or cut the power switch, even though he may have a remarkably fast reaction response time.

Would you be willing to spend less than one hour at the workbench to build a device, our Third Hand, since it can reduce, considerably, your concern over accidental losses of solid-state components due to overloads?

By Herb Friedman, W2ZLF & KBI9457



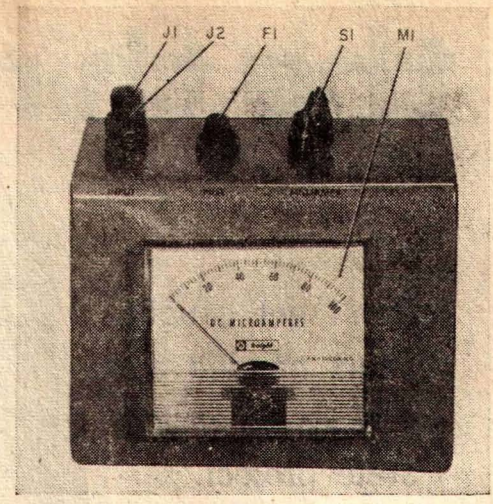
e/e THE THIRD HAND

We do not contend 100% immunity from such losses, but, we can assure you there will not be near as many as you had before having the Third Hand available.

How can we be so sure? Well, the Third Hand, actually a multi-range milliameter, is provided with an easy access fuse, connected in one of its legs. You can readily change the fuse last used to one specifically rated for the particular circuit involved, under test at the moment.

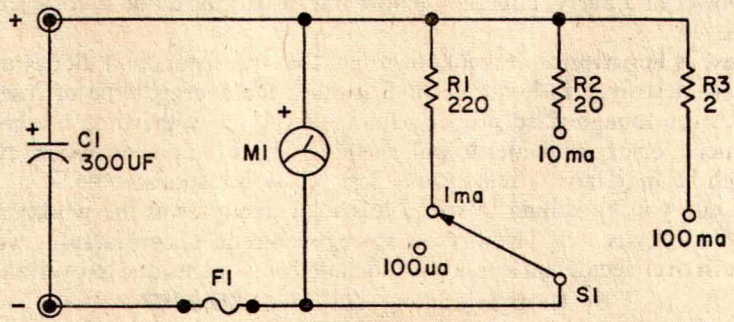
The Third Hand uses type 8AG, fast action, instrument fuses that were originally designed to protect delicate measuring instruments. We use them because they should blow before the solid-state components will be destroyed. Their fast action makes them far superior to 3AG fuses which are universally used in electronic test gear.

So you see, the Third Hand really is a multiple function device. It is a milliameter having many ranges and it also provides protection to solid-state components while adjusting and/or establishing operating parameters of solid-state equipment projects you may be working on. An added feature removes the common problem of having the meter impedance affect the circuit under test. The meter is by-passed for AC by capacitor C1 (see schematic below).



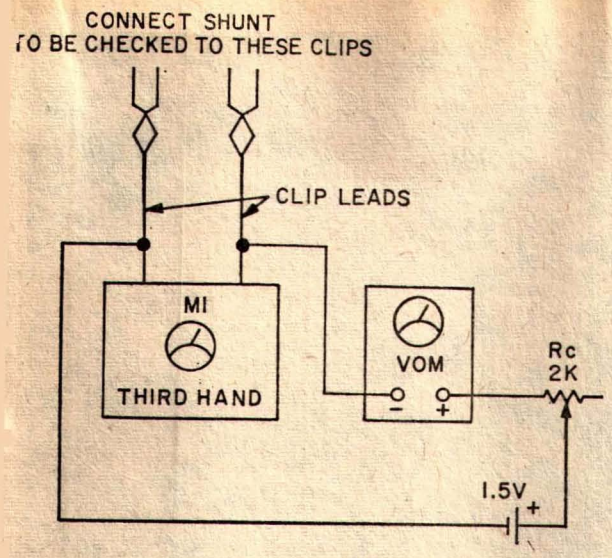
Front view of Third Hand detailing the location of controls. Note the large sized meter for easy reading; also fuse is handy at the top.

Here is an example of how this feature is advantageous. Let's assume a 2000 ohm, 100 *u*A meter is reading current drawn in a two transistor collector circuit. The impedance of the meter will isolate the common



PARTS LIST FOR THIRD HAND

C1—300 uF, 6.0V DC (or higher), electrolytic capacitor (Allied 43A6661 or equiv.) (see text)
F1—Type 8AG, fast action instrument fuse, various sizes (see text) (Allied 57A3214 through 57A3220 or equiv.)
M1—0-100 uA, 3½-in. square meter, Allied 52A7202, (see text)
R1—220 ohm, ½w, 5% resistor
R2—20 ohm, ½w, 5% resistor } (see text)
R3—2 ohm, ½w, 5% resistor
S1—Single pole, 5 position, make before break, rotary switch (Allied 56A4300 or equiv.)
1—Panel mounting fuse holder for 8AG fuses (Allied 57A3013 or equiv.)
1—4½ x 4 x 4-in. meter case (Allied 42A-8542 or equiv.)
1—Dual, 5-way binding post assembly (Allied 47A1328 or equiv.)
Misc.—Bolts, nuts, dry transfer letters for marking panel, hook-up wire, solder, etc.



Schematic for Calibration. In order to have the Third Hand readings exactly match readings of all other milliameters in the shop selection of shunts is made in this way. (See text for details)

collector voltage from the power supply filter capacitors by 2000 ohms, which, under certain conditions may cause motorboating. In the Third Hand, capacitor C1 bypasses AC around the meter, thus removing the problem of meter impedance.

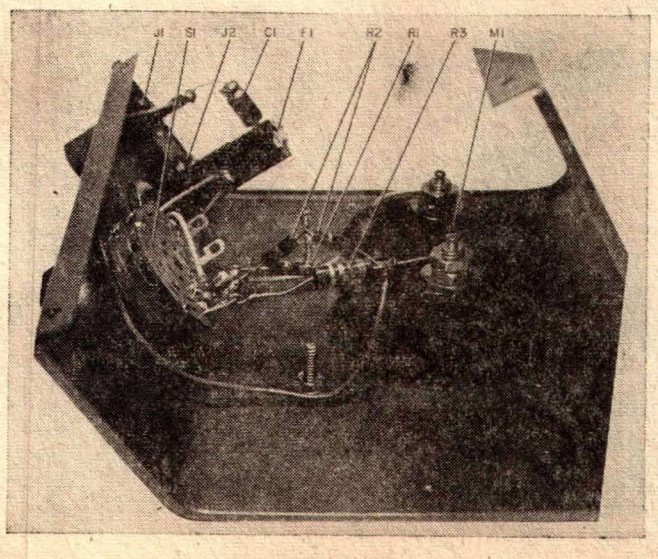
Building The Third Hand. Just by glancing at the schematic you can see that the Third Hand is basically a very simple device and even those with little construction experience should be able to complete this project easily in less than an hour. To save construction time that would be used up just in drilling the large hole for the meter we housed the instrument in a standard meter mounting box that is pre-drilled to fit the instrument (M1) shown in the parts list. The only hard(?) work other than drilling out for the meter involved in this project will be to drill mounting holes for S1, F1 holder and J1/J2. As you can see from the photos, the mounting and wiring of the components is very straightforward and should take very little time.

One of the nice features is that if you use the particular meter movement specified in the Parts List you may use standard values of 5% resistors as shunts to adapt the meter to be able to read the four ranges, rather than to have to go through the trials and tribulations of adding or subtracting wire, a turn at a time, to and from delicate wire wound shunts to arrive at the correct resistance needed.

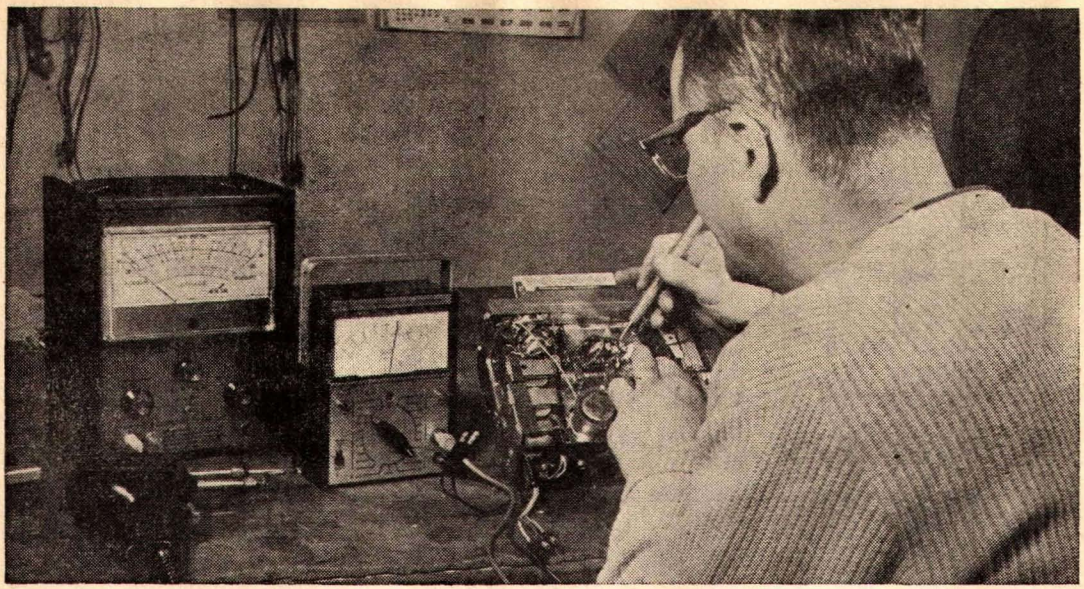
Calibrating The Third Hand. If you've ever gone through the routine of making your own custom, wire wound shunts you most certainly will appreciate being able to use standard resistors, most probably found in your stockpile.

The values of the meter shunts are sufficiently close to the values of standard 5% resistors so that you should be able to calibrate the Third Hand with a fair degree of accuracy with very little fuss or bother. In the event you are a stickler for precise matching of the readings between the various meters in your shop for the same test, then you can trim the resistance in the Third Hand circuit to an absolute value. To do this, temporarily hook up the Third Hand as shown in the schematic detailing calibration procedure. Using either a VOM, or virtually any other meter you want the Third Hand

(Continued on page 110)



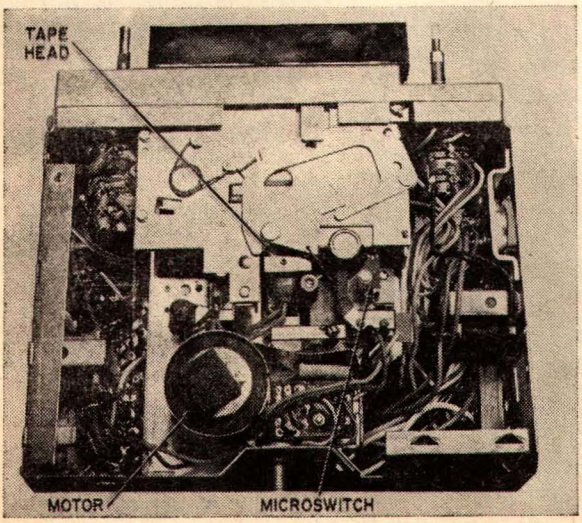
The Third Hand with cabinet opened to show parts layout. Note simplicity of construction and minimum need for hookup wire to interconnect components.



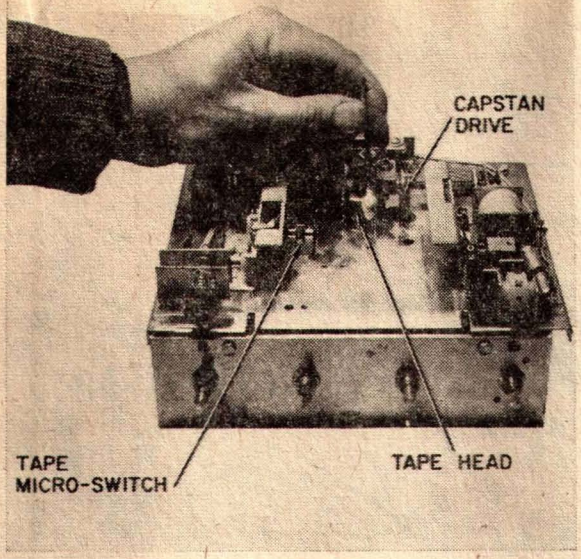
8 STEPS TO CAR

UNCLE SAM is spending millions to place men on the moon (rumor has it, in fact, that Rosemary's baby is scheduled for a moon landing, though nobody's saying just when). No one's denying that the Apollo missions are expensive and quite complicated electronically. Auto tape player repairs are expensive too, though unlike Apollo missions they needn't be—not if you fix your own.

In the Eight Steps you're about to see, you'll find meat enough to move you well along the way toward truly enjoyable music on the move. Only a few hand tools will be



1 Keep your eyes open as well as your mind when you remove the car tape player from under your dash, to the time you remove the chassis covers on your workbench. Very often a loose connection or screw can be fixed putting the player in tip top playing form. Once the covers are off, do some eyeball poking to turn up the trouble. Remember, most stereo tape player troubles are mechanical. Stop, think and try to isolate the trouble quickly before digging any deeper. And be sure not to misplace any hardware.



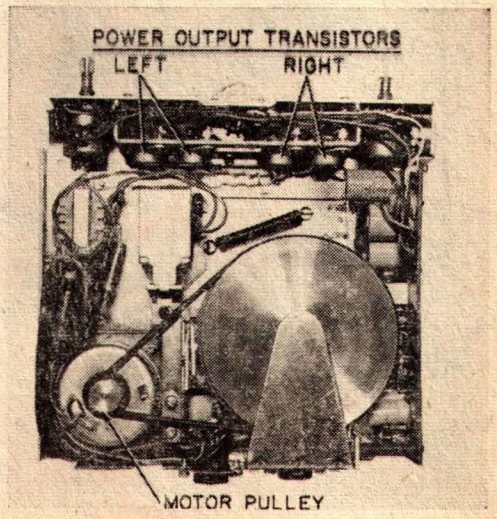
2 The most common trouble with auto tape machines is excessive dirt and dust. To ensure crisp tape reproduction, keep that tape head clean. A handy gadget to own is a tape head cleaning cartridge. At least once a week insert the cartridge to clean the head. At least once a year, or whenever playback reproduction is not up to par, do a thorough cleaning job. Clean tape head and tape guides with tape cleaning fluid. Apply fluid with a Q-tip. Denatured alcohol can be used. Also, remove tape oxide dust from head and motor capstan drive. Poke around and clean it all up. However, be sure not to throw any tape guides out of position.

by Homer L. Davidson

TAPE PLAYER REPAIR

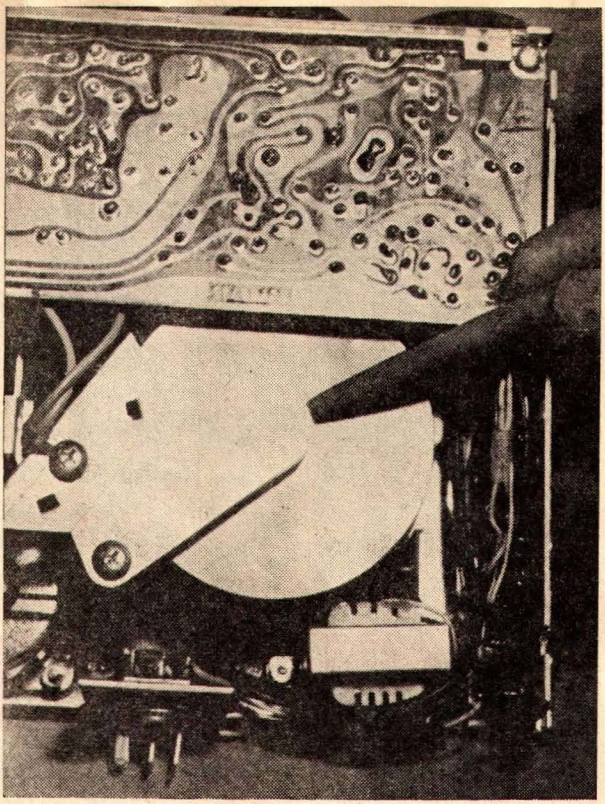
needed for most repairs. Just remember to use a pencil-type soldering iron when working in solid-state circuit boards, and don't forget that adage about fools rushing in where angels wouldn't be caught dead. Takeyour time, take things easy, and think! If you have a signal tracer, VTVM, and/or transistor tester around the shop, by all means drag 'em out and put 'em to work—if you can find work for them. But since most tape player troubles are mechanical in nature, the bulk of the problem rests with you. Ready to take the time to stop, think, and try to isolate that trouble? Then read on.

3 In many cases, dirt and grease will collect on the motor drive pulley and nearby metal parts. Simply remove all dirt and grease with denatured alcohol. Also, check that capstan flywheel and clean it if necessary. A bright slick-looking flywheel indicates slippage between the drive belt and flywheel. Clean thoroughly. If at all possible, try to find a replacement drive belt. You may have to write to the manufacturer. Power output transistors are installed with hardware that can loosen, causing poor electrical connection. Also, if not seated tightly on their heatsink surface, the power output transistors can overheat and destroy themselves. Be sure they are secured in their sockets.

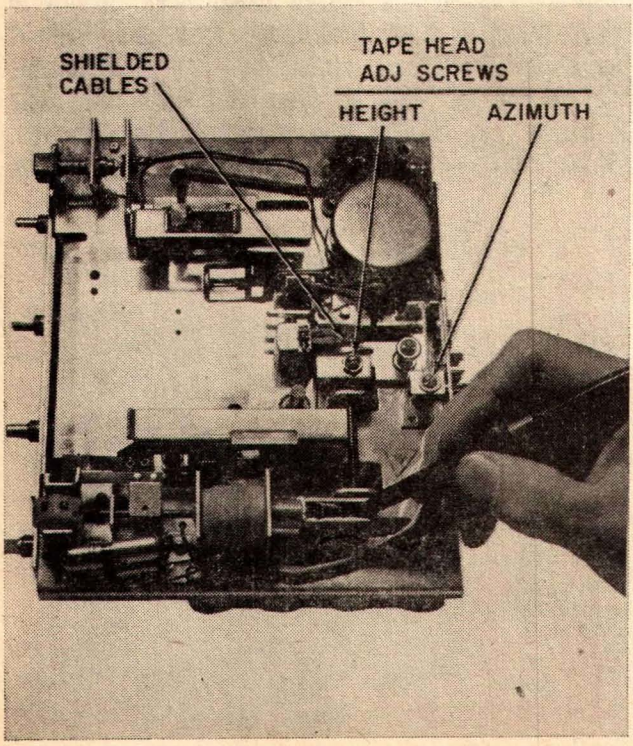


e/e TAPE PLAYER REPAIR

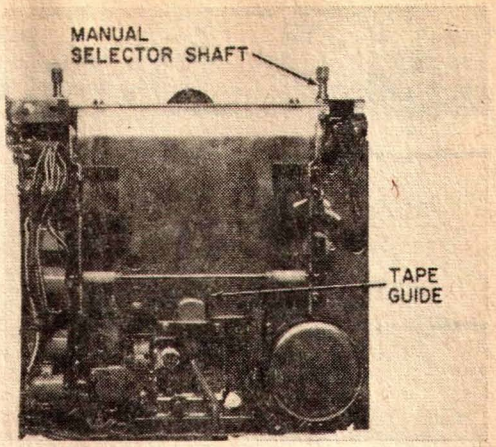
4 Excessive tape oxide dust within the flywheel bearing will cause slow and erratic tape speeds. Most capstan flywheels can be removed by pulling out a small keeper pin at the bottom bearing assembly. Now it will be easy to clean all bearing parts and surfaces nearby. Put a drop of oil into both bearings and re-assemble. Let the tape player run for a few minutes on the test bench and check for any oil that may work on the flywheel drive surface. Over lubrication may undo any good achieved.



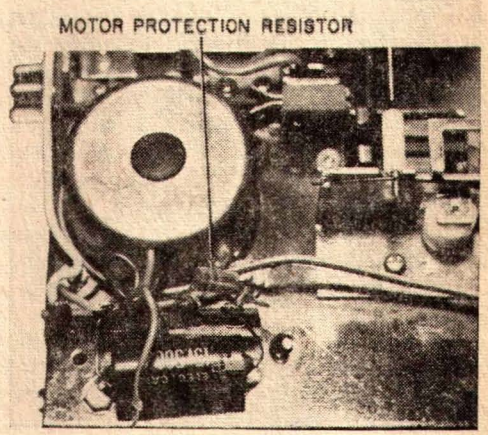
5 Does the tape refuse to change to another channel? Or perhaps, the solenoid is working and the channel indicator does not move? To find out what's up, connect power to the unit and listen to determine whether the solenoid is operating or not. A channel change can easily be heard while watching the ratchet. Determine whether the ratchet is turning over a small cam that lifts and lowers the tape head. Eyeballing it here will pin point simple mechanical problems that you can adjust to normal operation order. If the solenoid does not operate, it may be shorted out or have an open coil—call your VOM into action. If your playback is erratic or dead, check the shielded cables to the tape head. They can cause lots of trouble. If inspection does not pinpoint the cause of the trouble, you'll need the services of a signal tracer or injector. Be sure the volume control is set wide open.

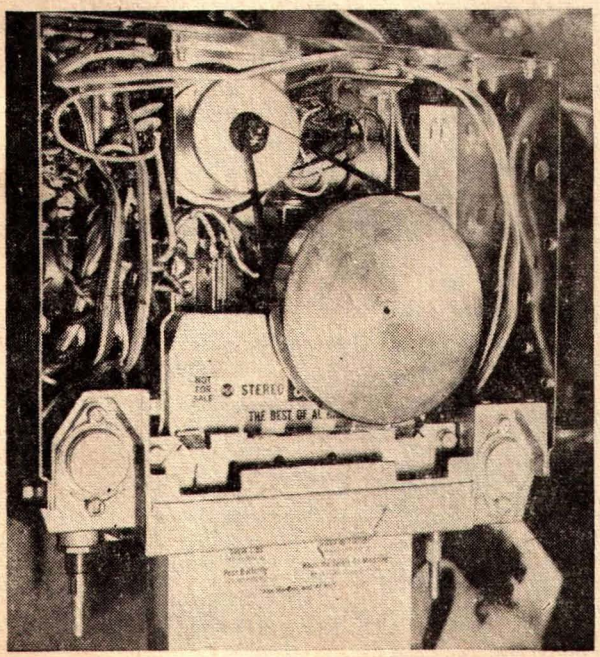


6 In case the stereo tape player will not manually change channels, suspect a dirty or broken manual change switch. Momentarily short the two contacts at the back of the change switch. If the solenoid is operating, the tape head will change positions. If not, trace out the wiring and look for a cold solder joint or break. If the switch is loose, it will promote frayed and broken wires. Try to determine cause of failure to prevent its recurrence.



7 Generally, when the tape becomes wound up into the capstan drive assembly, suspect a rough capstan drive or a poor cartridge. Do not allow the machine to run when jammed with tape. The motor will overheat. In this particular model, the motor protection resistor in series with the power supply burned out and was replaced. Most values are low—like 2.2 ohms. However, check the unit's schematic diagram to determine correct value and wattage. Of course, overheated motors often become defective and replacement is mandatory.





8 Before clamping the lid on a stereo tape player, give it a good bench preventative maintenance checkup. First, demagnetize the tape head. There are several inexpensive demagnetizers on the market. Second, use a test tape and check both amplifier channels and speakers for proper functioning. If you have the know how and manufacturer specs, check and align the tape head in azimuth and height. Next, install the machine under your dash, make power and speaker connections, snap in a tape cartridge. Now sit back and enjoy good stereo. ■

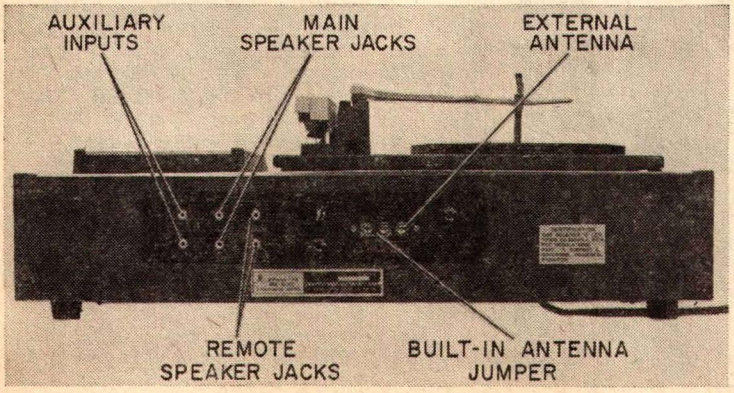
LAFAYETTE
Model RK-570
Stereo Compact Music System

☐ The Lafayette RK-570 music system, priced at $249.95 including two speakers, is so compact that just about anyone can have the advantage of a complete music system without the problem of where to put all the gear. Housed in a table-top cabinet measuring 20¾″W x 14½″D x 8″H, the RK-570 control center contains a stereo amplifier, an FM tuner, an automatic record changer and a cassette recorder. The separate speakers each measure 7″W x 12″H x 8″D and can be tucked away just about anyplace; in fact, they are light enough in weight to be hung on a wall easily with lightweight "finger-grips."

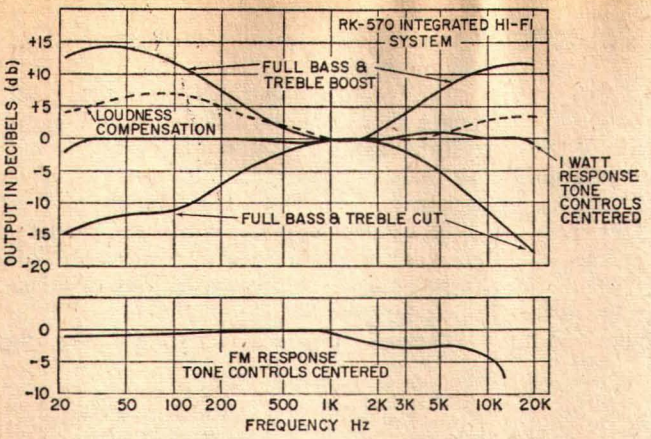
All controls and switches except for the remote speakers are mounted on a control panel which is the full width of the cabinet. Switches control AC power, speakers *on/off*, loudness compensation, amplifier/recorder function, stereo/mono mode, and record stereo/mono mode. Included on this panel are controls for tuning; separate concentric dual channel volume, bass and treble; a balance control and record volume. A switch on the recorder's volume control controls its power supply. Panel mounted jacks are provided for headphones and stereo microphones. A VU meter, whose pilot lamp indicates "recorder on," is used for setting recording gain, and is located conveniently for watching during a recording session.

By using normalled-thru microphone jacks the recorder can record from microphones or any external amplifier sound source. When microphones are plugged in the recorder is automatically disconnected from the amplifier input source switch. When the microphones are removed the cassette recorder feed is taken from the amplifier input selector so that whatever is being fed through the amplifier can be recorded simultaneously, if desired.

The recorder can be switched either four-track mono or two-track stereo depending on the setting of the record mode switch independently from the amplifier mode switch. Though only one record level meter is pro-



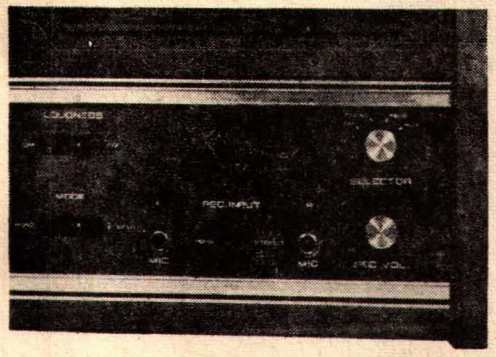
Termination panel on rear of control center provides connections for all external units of system—main and remote speakers, auxiliary inputs, and antenna. This self-contained control center is so well equipped with its own sources of input signals —FM-stereo, phono, tape cassette—that aux input will rarely, if ever, be needed.



These curves, which tell truthful tale on quality of overall system, look as good as unit sounds. With boost and cut controls centered, and at an output level of one watt, response curve for all intents and purposes could be drawn as straight line—not bad for a modest-priced system! Curves show effectiveness of both boost and cut ranges of comp circuits.

vided, an adding amplifier is connected across the stereo recording amplifier to provide a proper single meter indication for stereo.

Extra features include an FET tuner input (for resistance to overload from strong FM signals), a stereo indicator lamp, automatic FM-stereo/mono switching and a



All controls for all units housed in control center, except for cassette recorder, are conveniently located on this panel.

regulated power supply for the recorder's DC motor. A signal circuit extra includes an auxiliary input and remote speaker connection with a remote speaker selector switch. The external FM antenna input impedance is 300 ohms or internal antenna (by signal connection to the AC line cord). Accommodation is provided for either internal or external antenna, depending on the connection of the supplied antenna terminal jumper.

A Mini-Changer. The record changer is the so-called *mini* type, having a small base, a small platter and a DC motor that is powered from a 9VDC supply built into the amplifier. The pickup is a ceramic turnover cartridge with diamond LP needle. The changer handles all three record sizes and provides manual or automatic control and automatic shut-off.

You Can't Rattle Windows. While the amplifier's rated power of 6 watts IHF (5 watts RMS) per channel is not anywhere near the power ratings common to hi-fi amplifiers, the relatively high efficiency of the speakers supplied in the RK-570 package produce a considerable sound level from 5 watts, resulting in a total volume more than adequate for the average home. However, don't worry that the neighbors will be bothered by the excess volume.

Performance. Typical of all modern OTL (output transformer less) solid-state circuits the amplifier, within the rated power, is essentially distortion-free: at 5 RMS watts into 8 ohms the RK-570 checks in at 0.25% THD (total harmonic distortion). Also typical, the response between 20 and 20.000 Hz is essentially ruler flat at the normal 1 watt listening level. The response is within 2 dB at 5 watts (RMS) from 20 to 20,000 Hz, with less than 0.9% THD at 5 watts per channel. As shown in the curve the maximum tone control effects are very broad, permitting substantial equalization of the final sound. The loudness compensation shown is with the volume control approximately halfway open (1 watt output). One thing somewhat unusual is that the tone controls' "flat" position was not always centered for each sound source. Some correction, up to ⅛ rotation, was required to obtain "flat" response from different signal sources, but all inputs could be equalized "flat" to within 2 dB.

The FM Tuner. Tuner (through amplifier) checked out to have a sensitivity of 2.5 *u*V for 30 dB attenuation of hum, noise and distortion. Full limiting was obtained with a 12 *u*V input. Total FM distortion for

a 1000 *u*V input (standard) was 0.75% THD. As seen in the curve, with the tone controls centered there was roll-off of up to 7 dB out to 15 kHz, but a slight correction of the treble tone control flattened the response to 12 kHz.

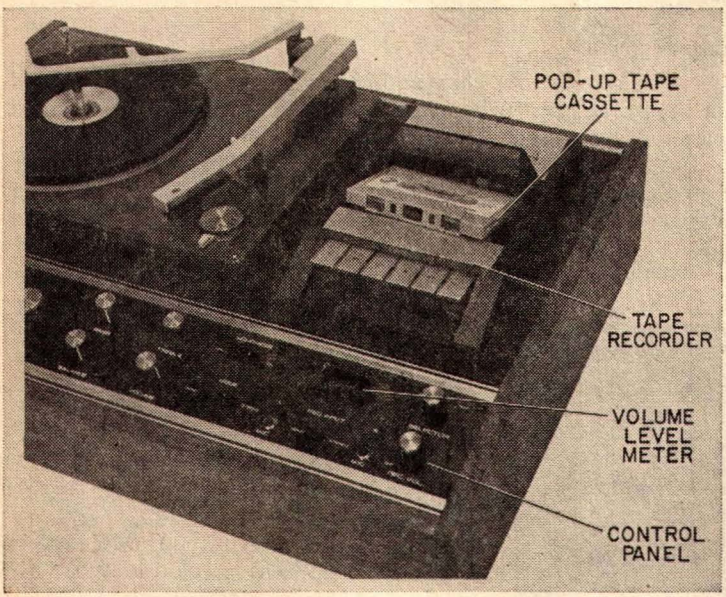
The Casette Recorder Mechanism is the pop-out cassette type with "piano key" push-button controls for: Record, Rewind, Stop, Play, Fast Forward, and Pause (for editing). As shown in the curve response is essentially "flat" from 20 to 6000 Hz, rolling off to 12 kHz. This is a typical cassette response for all but the hi-fi type recorders (which are relatively expensive). The response is perfectly adequate for general family use but not for so-called hi-fi recordings.

For general music wow and flutter was unnoticed, though some of the very cheap cassettes, with stiff or sloppy tape feeds, tended to reduce the tape speed slightly. (A good quality cassette should be used on any mechanism.)

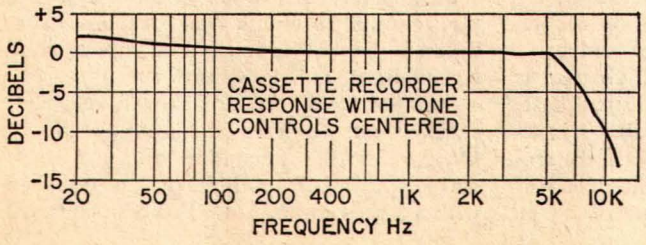
The record changer delivered quite good sound, though not of wide-range hi-fi quality. Although wow and flutter were low, and accuracy of speed good, the motor is lightweight and no more than three 12″ LPs could be stacked before there was a noticeable reduction in speed. However, a full stack of seven 45s could be used with no effect on speed.

Overall Impression. Considering its flexibility the RK-570 has an excellent and easy-to-use control layout such that even a child should have no trouble operating the controls. Though the RK-570 is not of *wide range* hi-fi sound quality, except for the FM and auxiliary inputs, it delivers a good solid "modern" sound akin to, or better than, most so-called hi-fi gear in its price range. It is an excellent value when you consider that for $249.95 the RK-570 represents a complete entertainment center (including speakers).

For additional information on the Lafayette RK-570 compact, write to Lafayette Radio Electronics, Dept. S, 111 Jericho Tpke., Syosset, N.Y. 11791. ■



Pop-up cassette tape recorder is placed near volume level meter on control panel which makes it easy to keep an eye on recording level when taping a program. Piano-key type controls and pop-up cartridge are great.



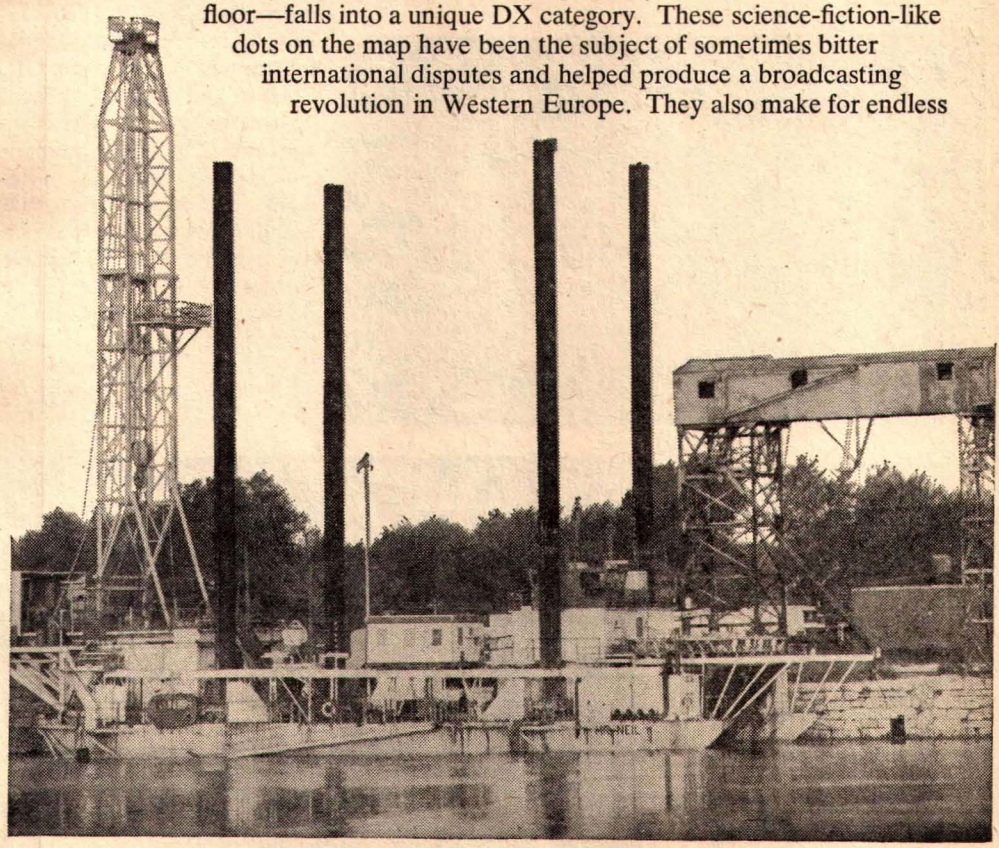
Cassette tape unit shows nearly flat response to about 6000 Hz. From 6 to 12,000 Hz it drops off uniformly to a maximum of 12 dB at 12,000 Hz. Overall response is fairly good.

off beat, off shore DX

Tune in the Islands that Aren't

by Stan Burrant

When is a DX island not an island? When it's man made? Maybe, but certainly such logging targets as abandoned anti-aircraft forts, off-shore radar towers, plus oil and gas wells in international waters—all of which (like natural islands) are firmly attached to the ocean floor—falls into a unique DX category. These science-fiction-like dots on the map have been the subject of sometimes bitter international disputes and helped produce a broadcasting revolution in Western Europe. They also make for endless



fun and games for distant radio listeners.

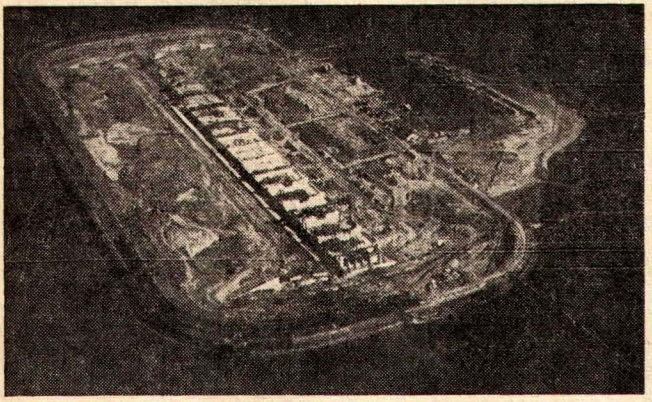
The Beatles At Sea. Probably the best known are those abandoned anti-aircraft fortresses off the British coast which figured so prominently for several years in the pirate radio scene and the revolution in pop music which went with it. One was the home of three successive pirate operations—R. Invicta (whose owner and two of the staff died under mysterious circumstances), R. King, and R. 390. Another fort, first held by R. Sutch (a creation of British R&R singer Screamin Lord Sutch) and then by R. City, was also involved in a violent death. Through some clever legal maneuvering, London seized control of and destroyed both these man-made islands.

The last of these abandoned forts is 12½ miles off the Essex coast and until recently was known as Rough's Tower. The individual presently in control, the former owner of shipboard pirate R. Essex, has renamed it "Sealand." This artificial nation had earlier been "colonized" by employees of R. Caroline, most famous of all the British radio bucaneers, who made several improvements including a helicopter platform. Then R. Essex boys seized the tower by force. And according to rumor, the present administration of Sealand plans not another radio station but a gambling casino.

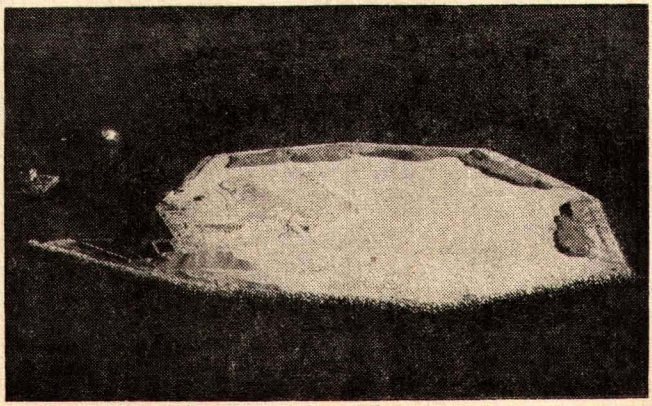
Typical off-shore ack-ack rigs with radio tower illustrates Radio 390 QSL card used to confirm their transmissions to British listeners.

Early in the summer of '68, reports circulated that a projected pirate voice calling itself Swinging R. Holland had purchased the 75-kW transmitter of defunct R. London and planned to set it up on Sealand. A few years ago the Dutch government annexed (by an act of parliament) a similar artificial island off its own coast which was then the home of R & TV Nordzee. Just how Swinging R. Holland plans to set up its transmitter remains a mystery, since anyone who ap-

(Continued on page 108)



Haringvliet, a man made island in the Netherlands. Aerial view shows trench or building pit. As construction progresses it is necessary to communicate with crew.



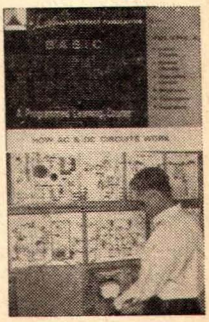
Island Bravo, a man made island off California. It's not hard to see the role communication plays in operations from this aerial view of the early construction stages.

e/e's all NEW BASIC COURSE in ELECTRICITY & ELECTRONICS*

PART 2

UNDERSTANDING DC PARALLEL CIRCUITS

WHAT YOU WILL LEARN. This second part of the all new Basic Course contains a thorough description of a DC parallel circuit. Included are the basic parallel connections, determination of total current and total resistance, the series equivalent circuit, current and voltage relationships, and typical applications of parallel circuits. You will learn how to identify parallel circuit networks, determine total current and total resistance, and develop series equivalent circuits. (*Turn page*)

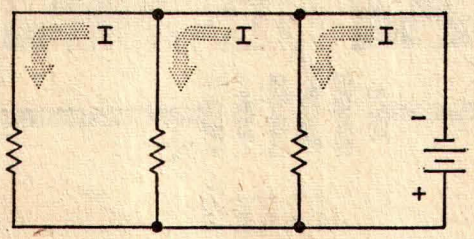


* This series is based on **Basic Electricity/Electronics**, Vol. 1, published by **Howard W. Sams & Co., Inc.**

WHAT IS A PARALLEL CIRCUIT?

A *parallel circuit* contains two or more basic circuits, each of which is connected to common terminal points. Two or more resistances, for example, may be connected together across the same voltage source.

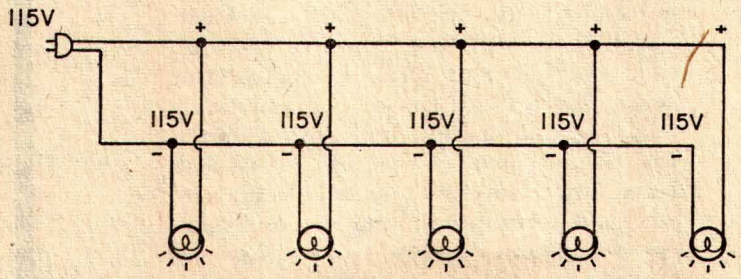
A Typical Parallel Circuit



A string of Christmas-tree lamps which will permit one or more lamps in the circuit to be opened and still allow the others to operate properly is one example of a parallel circuit. Each lamp has the same voltage applied to it.

Another form of parallel circuit uses more than one voltage source in parallel to increase the availability of current. The greater the amount of stored energy available, the longer the source can produce a current at a given voltage.

Christmas Lamps in Parallel

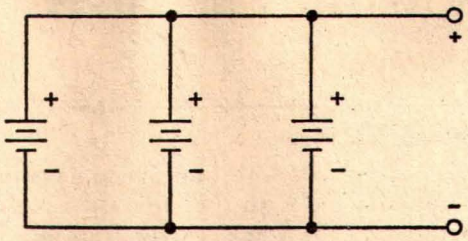


Still another example of a parallel circuit is the filament circuit for the vacuum tubes used in automobile radios. The filaments are all connected in parallel, and either 6 or 12 volts is applied to each. The tubes have either 6- or 12-volt filaments, depending on the type of battery in the automobile.

In each case, you can see that all sources or all loads are connected across the same two points. This produces a circuit which has one common voltage applied to all loads.

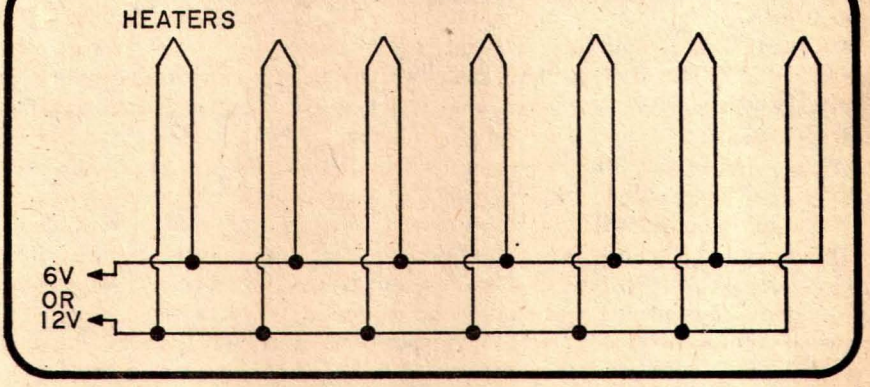
You have previously learned that in a series circuit all loads and sources are connected end to end. The same current flows through all components,

Batteries in Parallel Offer More Current



and the source voltage is divided among the separate loads. In a parallel circuit, all loads and sources are connected across the same points. Therefore, each load has the same voltage applied.

Vacuum-Tube Filaments in Parallel

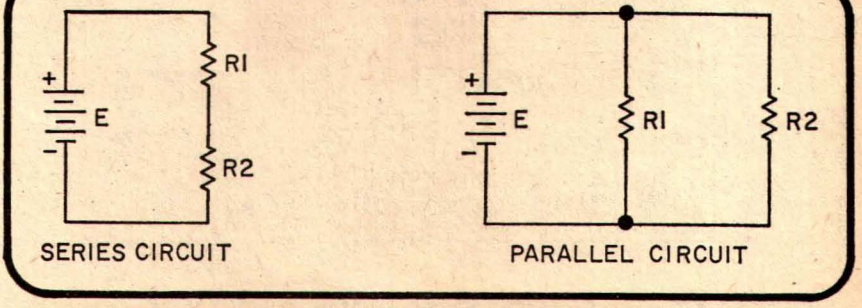


Q1. In a parallel circuit, each resistance can have the same (voltage, current) but different (voltage, current).

Q2. In a series circuit, each resistance can have the same (voltage, current) but different (voltage, current).

Answers on next page.

Load and Source Connections



Your Answers Should Be:

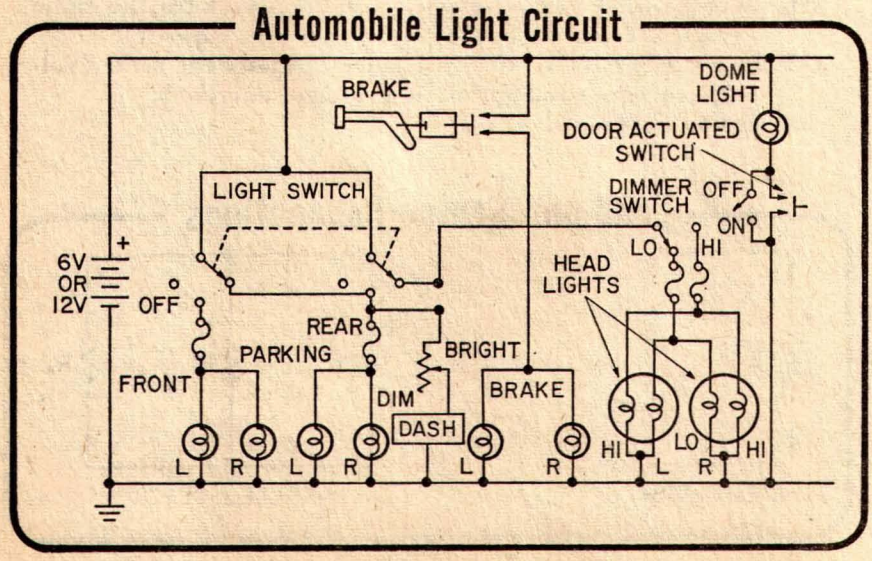
A1. In a parallel circuit, each resistance can have the same *voltage* but different *current*. With the same voltage across each load, current will equal the voltage divided by the load resistance.

A2. In a series circuit each resistance can have the same *current* but different *voltage*.

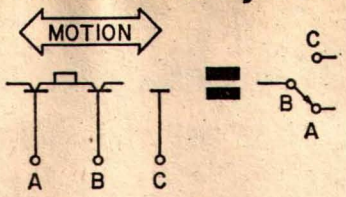
AUTOMOBILE CIRCUITS

The diagram below is an example of a schematic for a lighting circuit in an automobile, and is also an example of a parallel circuit. Notice that fuses are used in the separate branches. This permits one circuit to short and blow its fuse while the other circuits remain energized. Notice that different switches are used for different jobs. The main light switch might be a rotary type (wafer). The stop-light switch is usually actuated by the same hydraulic fluid pressure that applies the brakes. That is, the switch is a push-button type that is spring-loaded to form a normally open circuit. When the brakes are applied, pressure builds up in the master brake cylinder, causing the stop-light switch to close. The head-light dimmer switch is located on the floor of most cars. It is a push-button switch which remains in one position until pressed again. The dome light is switched on and off by either of two switches in parallel. One is a push-button type that is spring-loaded to stay normally closed, and is actuated by opening and closing the car door. When the door opens, the switch returns to its normally closed position; when the door is closed, it pushes the switch open. In parallel with this switch is a slide switch, sometimes a part of the dome-light fixture.

Automobile Light Circuit



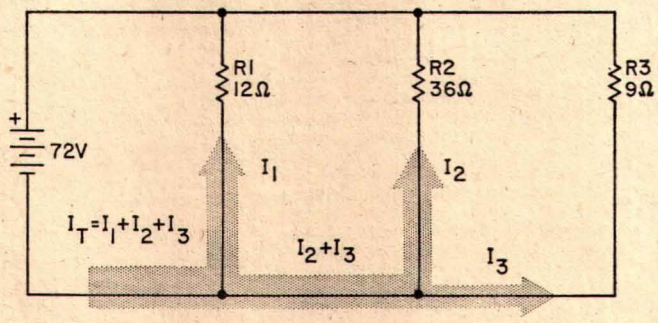
Slide Switch Symbol



CURRENT FLOW IN A PARALLEL CIRCUIT

Current in each branch of a parallel circuit must originate from the same source. This means that each branch will have a different current if the resistance of each branch is different. The source must supply current for each branch, so the total current is the sum of all the branch currents.

Total Current Is the Sum of the Branch Currents



Q3. What is common to all light circuits in a car?

Q4. What sort of a load does a car battery have?

Q5. The total current in a parallel circuit is the – – – of all the branch currents.

Your Answers Should Be:

A3. *The voltage source.*

A4. Since more than one circuit can be switched into use, the battery can have many different loads. The total load is the *sum* of the individual loads.

A5. The total current in a parallel circuit is the *sum* of all the branch currents.

Calculating Current in a Parallel Circuit

To find the current in each branch of a parallel circuit you must apply Ohm's law; that is, E/R equals I for each branch. In the diagram immediately above, I_1 (branch 1) will equal 72/12 I_2 (branch 2) will equal

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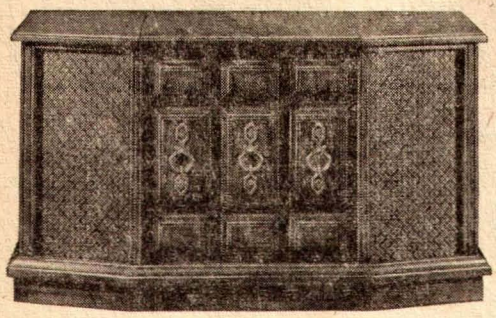

Mediterranean Styling . . . 30-Watt FM-Stereo Receiver . . . 4-Speed Automatic Turntable . . . Full-Range Speaker Systems

• Combines all solid-state FM stereo receiver, 4-speed automatic turntable with diamond stylus and two full-range, two-way speaker systems into a luxurious Mediterranean cabinet • 15 watts per channel music power output • Full range tone controls • Very low Harmonic & IM Distortion • Excellent channel separation • Transformerless output circuit for minimum phase shift, wide response • Electronically filtered power supply • Stereo headphone jack • Auxiliary input • Filtered tape output • Excellent FM tuner selectivity & sensitivity • 4-stage IF • AFC • Stereo indicator light • SCA filter • High quality BSR McDonald 500A Automatic Turntable with low mass counterbalanced aluminum tone arm plays up to 6 records • Comes with Shure diamond stylus magnetic cartridge • Vernier stylus pressure adjustment • Anti-Skate control • Cue/Pause control • Two ducted-port reflex 2-way speaker systems for performance comparable to fine component-type separate speaker systems • Each system contains 10" high compliance woofer & 3½" ring-damped tweeter for 60-16,000 Hz response • Complete system housed in a magnificent factory assembled Mediterranean cabinet of beautiful oak veneers with solid oak trim • Easy assembly with the famous Heathkit Manual . . . build only the receiver & install the components • The finest value anywhere in quality stereo consoles

Real Stereo Performance Demands Real Stereo Components . . . the kind used for custom-designed systems. The new "Component Credenza", as the name implies, integrates separate components into a single functional unit. Here are those components . . .

Component-Quality FM Stereo Receiver. The heart of the new AD-19 is the famous Heathkit AR-14 FM-FM-Stereo Receiver circuitry. The amplifier produces a solid 30 watts IHF music power. The FM Stereo tuner features 5 uV sensitivity, excellent separation and flywheel tuning. The AR-14 has been rated as the best value obtainable in a medium power receiver.

Component-Quality 4-Speed Automatic Turntable with such professional features as Cue/Pause control, Anti-Skate control, adjustable stylus pressure and famous Shure diamond stylus magnetic cartridge.

Component-Quality Speaker Systems. Two independent, ported speaker systems, each with a 10" woofer and 3 x 3 ½" tweeter deliver 60-16,000 Hz response for remarkable fidelity.

Elegant Mediterranean Oak Cabinet . . . a fine example of cabinet-making, flawlessly executed in oak veneer with solid oak trim. Rigidly constructed using fine-furniture techniques.

The New Heathkit AD-19 "Component Credenza". . . A Masterpiece in sight and sound. Put it in your home now.

Kit AD-19, 158 lbs. **$299.95***

NEW Heathkit GR-78 Solid-State General Coverage Receiver... Tunes 190 kHz To 30 MHz In Six Bands

The new GR-78 combines wide coverage, superior performance and portability with sharp styling to provide a remarkable value in general coverage receivers. Tunes AM, CW & SSB signals from 190 kHz to 30 MHz in six switch-selected bands. The all solid-state circuit employs modern FET's in the RF section and 4 ceramic filters in the IF to deliver maximum sensitivity and sharp selectivity. Bandspread Tuning is built-in, and can be calibrated for either Shortwave Broadcast or Amateur Bands. Completely portable . . . comes with a nickel-cadmium rechargeable battery pack and built-in charger that operates from 120 or 240 VAC and 12 VDC. Many built-in features . . . 500 kHz crystal calibrator . . . switchable Automatic Noise Limiter . . . switchable Automatic Volume Control . . . Receiver Muting . . . Headphone Jack and many more. Order yours today. 14 lbs.

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The next best thing to a personal doorman. The "wireless" factory assembled transmitter operates up to 150 feet away. Just push the button and your garage door opens and the light turns on . . . and stays on until you're safely inside your home. The giant 7 ft. screw mechanism coupled with the ¼ HP motor mean real power and reliability and the adjustable spring-tension clutch automatically reverses the door when it meets any obstruction . . . extra safety for kids, pets, bikes, even car tops. Assembles completely without soldering in just one evening. Easy, fast installation on any 7' overhead track (and jamb & pivot doors with accessory adapter). Order yours now. 66 lbs.

Adapter arm for jamb & pivot doors, Model GDA-209-2, $7.95*

From The Leader

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NEW Heathkit Ultra-Deluxe "681" Color TV With AFT . . . Power Channel Selection & Opt. RCA Hi-Lite Matrix Tube

The new Heathkit GR-681 is the world's most advanced Color TV with more built-in features than any other set on the market. Automatic Fine Tuning on all 83 channels . . . power push button VHF channel selection, built-in cable-type remote control . . . or you can add the optional GRA-681-6 Wireless Remote Control any time . . . plus the built-in self-servicing aids that are standard on all Heathkit color TV's. Other features include high & low AC taps to insure that the picture transmitted exactly fits the "681" screen, automatic degaussing, 2-speed transistor UHF tuner, hi-fi sound output, two VHF antenna inputs, top quality American brand color tube with 2-year warranty. With optional new RCA Matrix picture tube that doubles the brightness, **Model GR-681MX only $535.00.**

GRA-295-4, Mediterranean Cabinet shown **$124.95***

Heathkit "295" Color TV

With Optional RCA Matrix Tube . . . with the same high performance features and built-in servicing facilities as GR-681 above . . . less AFT, VHF power tuning and built-in cable-type remote control. You can add the optional GRA-295-6 Wireless Remote Control at any time. New optional RCA Matrix tube doubles the brightness, **Model GR-295MX, $485.00.**

GRA-295-1, Contemporary Walnut Cabinet shown **$64.95***

Both the GR-681 and GR-295 fit into the same Heath factory assembled cabinets; not shown Early American style at $109.95*

NEW Deluxe Heathkit "581" Color TV With AFT

The new Heathkit GR-581 will add a new dimension to your TV viewing. Brings you color pictures so beautiful, so natural, so real . . . puts professional motion picture quality right into your living room. Has the same high performance features and exclusive self-servicing facilities as the GR-681, except with 227 sq. inch viewing area, and without power VHF tuning or built-in cable-type remote control. The optional GRA-227-6 Wireless Remote Control can be added any time you wish. And like all Heathkit Color TV's you have a choice of different installations . . . mount it in a wall, your own custom cabinet, your favorite B&W TV cabinet, or any one of the Heath factory assembled cabinets.

GRA-227-2, Mediterranean Oak Cabinet shown **$109.95***

Heathkit "227" Color TV

Same as the GR-581 above, but without Automatic Fine Tuning . . . same superlative performance, same remarkable color picture quality, same built-in servicing aids. Like all Heathkit Color TV's you can add optional Wireless Remote Control at any time (GRA-227-6). And the new Table Model TV Cabinet and roll around Cart is an economical way to house your "227" . . . just roll it anywhere, its rich appearance will enhance any room decor.

GRS-227-5, New Cart and Cabinet combo shown **$54.95***

Both the GR-581 and GR-227 fit into the same Heath factory assembled cabinets; not shown, Contemporary cabinet $64.95*

NEW Heathkit Deluxe "481" Color TV With AFT

The new Heathkit GR-481 has all the same high performance features and exclusive self-servicing aids as the new GR-581, but with a smaller tube size . . . 180 sq. inches. And like all Heathkit Color TV's it's easy to assemble . . . no experience needed. The famous Heathkit Color TV Manual guides you every step of the way with simple to understand instructions, giant fold-out pictorials . . . even lets you do your own servicing for savings of over $200 throughout the life of your set. If you want a deluxe color TV at a budget price the new Heathkit GR-481 is for you.

GRA-180-1, Contemporary Walnut Cabinet shown **$49.95***

Heathkit "180" Color TV

Feature for feature the Heathkit "180" is your best buy in color TV viewing . . . has all the superlative performance characteristics of the GR-481, but less Automatic Fine Tuning. For extra savings, extra beauty and convenience, add the table model cabinet and mobile cart. Get the value-packed GR-180 today.

GRS-180-5, Table Model Cabinet & Cart combo **$42.50***

Both the GR-481 and GR-180 fit the same Heath factory assembled cabinets; GRA-180-2, Early American Cabinet $94.95*.

Add the Comfort And Convenience Of Full Color-Wireless Remote Control To Any Rectangular Tube Heathkit Color TV . . . New Or Old!

Kit GRA-681-6, for Heathkit GR-681 Color TV's. **$64.95***

Kit GRA-295-6, for Heathkit GR-295 & GR-25 TV's. **$69.95***

Kit GRA-227-6, for Heathkit GR-581; GR-481 & GR-180 Color TV's **$69.95***

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2 Models In 295 Sq. Inch Size

NEW Kit GR-681 With AFT $499.95* (less cabinet)

Kit GR-295 $449.95* (less cabinet)

2 Models In 227 Sq. Inch Size

NEW Kit GR-581 with AFT $419.95* (less cabinet)

Kit GR-227 NOW ONLY $379.95* (less cabinet & cart)

2 Models In 180 Sq. Inch Size

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72/36, and I_3 (branch 3) will equal 72/9. The current in breach 1, therefore, is 6 amps; in branch 2 there is 2 amps; and in branch 3 there is 8 amps. Total current supplied by the source is 16 amps.

CALCULATING TOTAL RESISTANCE

Since I_T in a parallel circuit is equal to the sum of all branch currents, R_T is equal to E/I_T. Also, I_T equals the source voltage divided by R_T, and I (any branch) equals the source voltage divided by the resistance of that branch.

$$I_1 = \frac{E}{R_1},\ I_2 = \frac{E}{R_2},\ \text{and}\ I_3 = \frac{E}{R_3}$$

Substituting for I_T, I_1 (branch 1), etc.

$$(1)\quad I_T = I_1 + I_2 + I_3$$

$$(2)\quad \frac{E}{R_T} = \frac{E}{R_1} + \frac{E}{R_2} + \frac{E}{R_3}$$

E can be any value you choose for the solution of R_T. This leads to two possible methods of solving for R_T.

First Process—R_T can be found by assuming any value for E that is easy to work with. Then, divide each resistance into E to find I for each branch.

As an example, imagine a parallel circuit having resistances of 100, 200, and 200 ohms. Select a value for E that permits an easy solution for all branches, such as 100 volts. Therefore, $E/R_1 = I_1$, $E/R_2 = I_2$, and $E/R_3 = I_3$. $I_1 = 100/100 = 1$ amp, $I_2 = 100/200 = 0.5$ amp, and $I_3 = 100/200 = 0.5$ amp. Now, find the sum of the branch currents to determine I_T.

$$I_T = I_1 + I_2 + I_3 = 1a + 0.5a + 0.5a = 2a$$

You now know I_T for a selected E. All that remains in order to find R_T is to divide the assumed voltage by the amount of total current the parallel resistances allow to flow.

$$R_T = \frac{E}{I} = \frac{100}{2} = 50\ \text{ohms}$$

The shorthand statement that describes all of the operations used in finding the total resistance (50 ohms) is:

$$R_T = \frac{E}{I}$$

Since,

$$I_T = \frac{E}{R_1} + \frac{E}{R_2} + \frac{E}{R_3}$$

and,

$$E = 100 \text{ volts}$$

then,

$$R_T = \frac{100}{1 + 0.5 + 0.5} = \frac{100}{2} = 50 \text{ ohms}$$

Second Process—Looking at the expression $I_T = I_1 + I_2 + I_3$ and using its equivalent expression, $E/R_T = E/R_1 + E/R_2 + E/R_3$, you can arrive at the same expression for R_T as before.

$$\frac{E}{R_T} = \frac{E}{R_1} + \frac{E}{R_2} + \frac{E}{R_3}$$

Now, follow these steps closely.

1. $\left(\frac{E}{R_T}\right)R_T = \left(\frac{E}{R_1} + \frac{E}{R_2} + \frac{E}{R_3}\right)R_T$ (Multiplying both sides by R_T.)

2. $E\left(\frac{R_T}{R_T}\right) = \left(\frac{E}{R_1} + \frac{E}{R_2} + \frac{E}{R_3}\right)R_T$ (R_T's on left cancel.)

(Divide both sides by I_T and cancel the like quantities on right.)

3. $$\frac{E}{\frac{E}{R_1} + \frac{E}{R_2} + \frac{E}{R_3}} = \frac{\left(\frac{E}{R_1} + \frac{E}{R_2} + \frac{E}{R_3}\right)}{\frac{E}{R_1} + \frac{E}{R_2} + \frac{E}{R_3}} R_T$$

4. $$\frac{E}{\frac{E}{R_1} + \frac{E}{R_2} + \frac{E}{R_3}} = R_T$$

$R_1 = 100\ \Omega$, $R_2 = 200\ \Omega$, $R_3 = 200\ \Omega$, and 100 volts was previously selected for E. Now, substitute and perform the arithmetic to solve for R_T.

$$R_T = \frac{100V}{\frac{100V}{100\Omega} + \frac{100V}{200\Omega} + \frac{100V}{200\Omega}}$$

$$= \frac{100V}{1 \text{ amp} + 0.5 \text{ amp} + 0.5 \text{ amp}}$$

$$= \frac{100V}{2 \text{ amp}} = 50 \text{ ohms}$$

The two processes have led you to the common expression used in the field for the total resistance of a parallel circuit. ("1" is used as the common value for E.)

$$R_T = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots + \frac{1}{R_n}}$$

This is called a *reciprocal* expression because there are operations in which

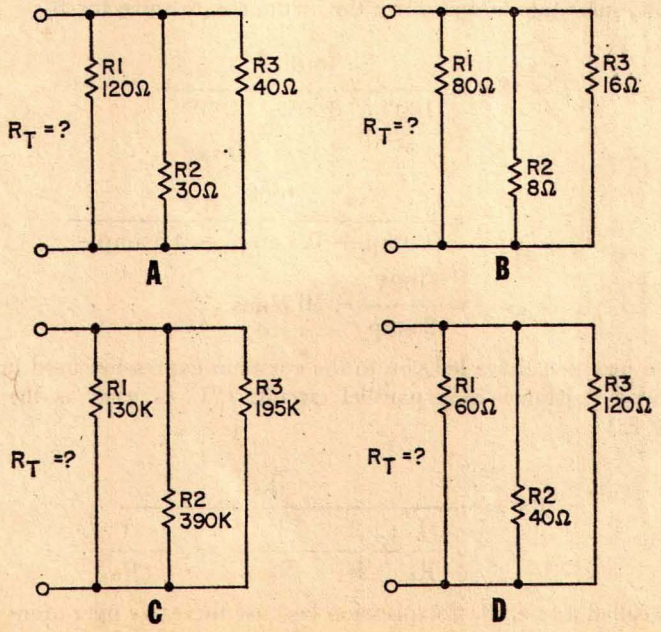
a value is divided into one. You will find this true for many different mathematical operations. To improve your ability to apply them, examine such expressions to determine the several arithmetic operations each contains. The development of mathematical processes is not often explained in technical literature. Difficult expressions, such as the reciprocal formula above, contain simple arithmetic steps that make the "shorthand" expression reasonable and meaningful. Find and analyze these steps. Acceptance or memorization is of little value unless you understand the reasoning behind each expression.

You should now review the entire process (the solution or R_T) until all steps are clear and appear reasonable to you. Evaluate each new step with questions, such as, "Why perform this operation?" or "What arithmetic operations are the symbols representing?" Remember that any operation you will ever follow is nothing more than arithmetic applied with logical rules and sequences.

Many times you will be faced with a "new" mathematical expression (at least it will be strange to you). If you determine the answer to the two questions above, you will find there is a simple hidden reason or step.

The question below asks you to find the solution for R_T, using either process. If you do not use the reciprocal form, E can have any value you choose to select. Your selection should be one that permits simple number operations with arithmetic. A hint for the selection of E—always select a value for E equal to or larger than the largest resistance. Another hint—try to select a value for E which results in a whole number when divided by any value of R. Don't forget the Ohm's law relationship where $R_T = E/I_T$.

Q6. What is the total resistance of the following circuits?



Your Answers Should Be:

A6. (a) Select E of 120V

$$R_T = \frac{E}{I_T} = \frac{120V}{\frac{120V}{120\Omega} + \frac{120V}{30\Omega} + \frac{120V}{40\Omega}}$$

$$R_T = \frac{120V}{1a + 4a + 3a} = \frac{120V}{8a} = 15 \text{ ohms}$$

(b) Select E of 80V

$$R_T = \frac{E}{I_T} = \frac{80V}{\frac{80V}{80} + \frac{80V}{8} + \frac{80V}{16}}$$

$$R_T = \frac{80V}{1a + 10a + 5a} = \frac{80V}{16a} = 5 \text{ ohms}$$

(c) Select an E of 390V

$$R_T = \frac{E}{I_T} = \frac{390V}{\frac{390V}{130K} + \frac{390V}{390K} + \frac{390V}{195K}}$$

$$R_T = \frac{390V}{3ma + 1ma + 2ma} = \frac{390V}{6ma} = 65K$$

(d) Select an E of 120V

$$R_T = \frac{E}{I_T} = \frac{120V}{\frac{120V}{60} + \frac{120V}{40} + \frac{120V}{120}}$$

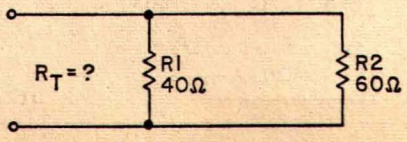
$$R_T = \frac{120V}{2a + 3a + 1a} = \frac{120V}{6a} = 20 \text{ ohms}$$

Total R in a Two-Branch Circuit

Another method for finding the total resistance of a two-branch parallel circuit is the *product-over-the-sum* process. Given the values of two resistors in parallel, multiply one times the other and divide by the sum of the two.

$$R_T = \frac{R_1 \times R_2}{R_1 + R_2}$$

The total resistance of the parallel circuit below is 24 ohms. This can be determined by using the product-over-the-sum process.



$$R_T = \frac{40 \times 60}{40 + 60} = \frac{2{,}400}{100} = 24 \text{ ohms}$$

$$R_T = \frac{E}{\frac{E}{R_1} + \frac{E}{R_2}} = \frac{E}{\frac{E_{R2} + E_{R1}}{R_1 \times R_2}} = \frac{E(R_1 \times R_2)}{E(R_2 + R_1)}$$

To find the total resistance of a parallel circuit containing resistors of equal value in parallel, all that needs to be done is to divide the value of one of the resistors by the number of resistors in parallel.

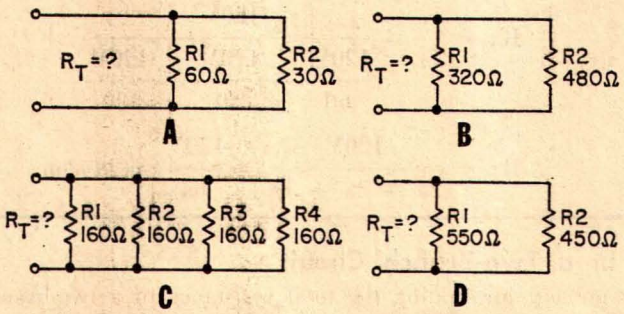
If a parallel circuit, for example, contains three 90-ohm resistors, R_T can be determined by dividing 90 by 3.

$$R_T = \frac{90}{\frac{90}{90} + \frac{90}{90} + \frac{90}{90}} \quad \text{(selecting an E of 90)}$$

$$= \frac{90}{1 + 1 + 1}$$

$$= \frac{90}{3} = 30 \text{ ohms}$$

Q7. What is the total resistance of these circuits?



Your Answers Should Be:

A 7. (a) $R_T = \frac{R_1 \times R_2}{R_1 + R_2} = \frac{60 \times 30}{60 + 30} = \frac{1{,}800}{90} = 20$ *ohms*

(b) $R_T = \frac{320 \times 480}{320 + 480} = \frac{153{,}600}{800} = 192$ *ohms*

(c) $R_T = \frac{160}{4} = 40$ *ohms*

(Continued next page)

(d) $R_T = \frac{550 \times 450}{550 + 450} = \frac{247{,}500}{1{,}000} = 247.5 \text{ ohms}$

Equivalent Resistance

Just as in the series circuit, the resistances in a parallel circuit can be represented by an equivalent. The equivalent indicates the load (R_T) which the source must work into. Since I_T is the easiest unknown to find (it is the sum of all the currents), it becomes a simple task to divide I_T into the source voltage to find R_T.

By the same reasoning, it is easy to find the power that the source must supply.

$$P = IE$$

In this case:

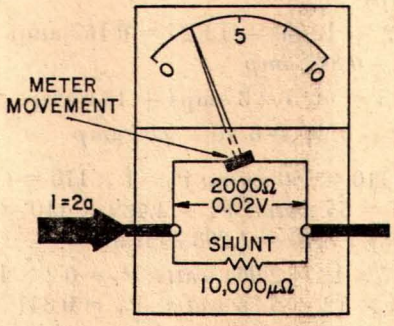
$$P_T = (I_1 \times E) + (I_2 \times E) + (I_3 \times E) = I_T E$$

TYPICAL APPLICATIONS

A parallel circuit is used where current is to be divided. This is similar to the action of the series circuit, except that voltage was divided.

Current Meter—An ammeter is used to indicate the amount of current flowing in a circuit. Very often the meter used will be one that has a full-scale deflection, indicating an amount of current much less than the circuit current to be measured. There is a method of bypassing the meter with the excess current. This is called *shunting* the meter. With a shunt, the meter reads a percentage of the total current. This means normal current flows through the entire parallel network (consisting of the meter and shunt), with only a small portion flowing through the meter.

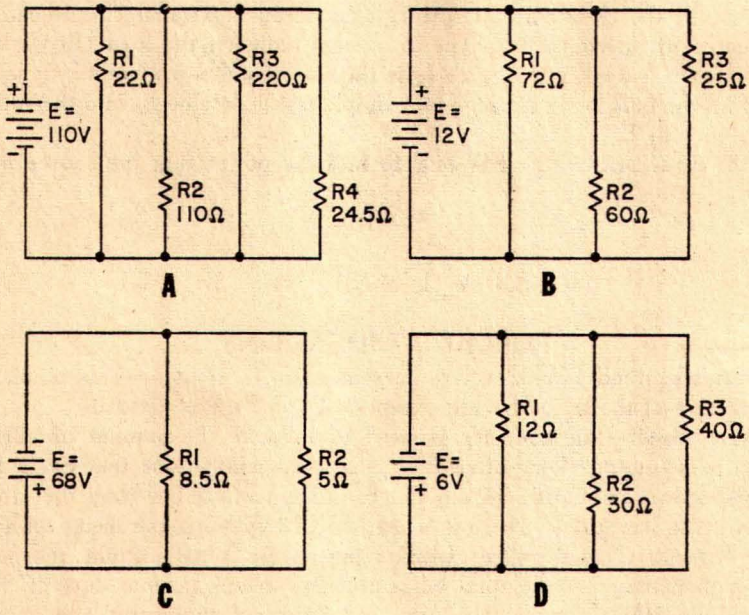
An Ammeter with a Shunt



This meter has a movement with 2,000 ohms of resistance and is shunted by a 10,000 micro-ohm (0.01 ohm) resistor. This permits μa of current to flow through the movement and 2 amps (minus the 10 μa) of current of flow through the shunt. These may not be the exact values for a particular multimeter, but all multimeters employ similar ratios.

Q8. What is the total current in the following circuits?

Q9. What is the power dissipated by each resistor and the total power for each circuit shown at the top of next page?



Your Answers Should Be:

A8. (a) $I_T = I_1 + I_2 + I_3 + I_4 = 110/22 + 110/110 + 110/220 + 110/24.5 = 5$ amps $+ 1$ amp $+ 0.5$ amp $+ 4.489$ amps $=$ *10.989 amps*

(b) $I_T = 12/72 + 12/60 + 12/25 = 0.167$ amp $+ 0.2$ amp $+ 0.48$ amp $=$ *0.847 amp*

(c) $I_T = 68/8.5 + 68/5 = 8$ amps $+ 13.6$ amps $=$ *21.6 amps*

(d) $I_T = 6/12 + 6/30 + 6/40 =$ *0.85 amp*

A9. (a) $P_1 = 5 \times 110 =$ *550 watts*; $P_2 = 1 \times 110 =$ *110 watts*; $P_3 = 0.5 \times 110 =$ *55 watts*; $P_4 = 4.489 \times 110 =$ *493.79 watts*; $P_T = 10.989 \times 110 =$ *1,208.79 watts*

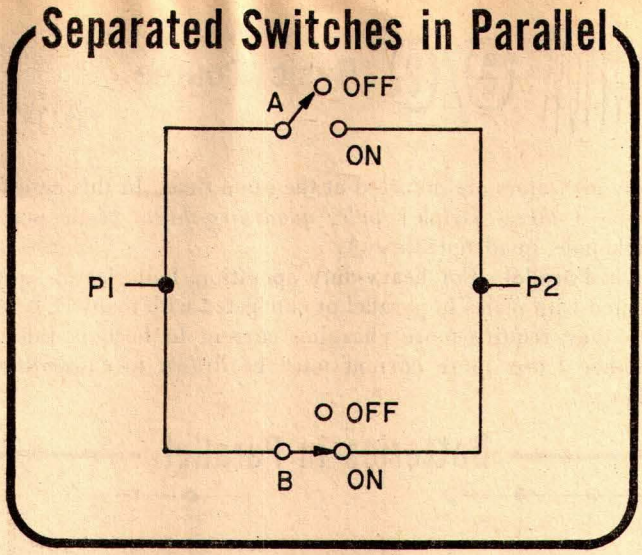
(b) $P_1 = 0.167 \times 12 =$ *2.004 watts*; $P_2 = 0.2 \times 12 =$ *2.4 watts*; $P_3 = 0.48 \times 12 =$ *5.76 watts*; $P_T = 0.847 \times 12 =$ *10.164 watts*

(c) $P_1 = 8 \times 68 =$ *544 watts*; $P_2 = 13.6 \times 68 =$ *924.8* watts; $P_T = 216 \times 68 =$ *1,468.8 watts*

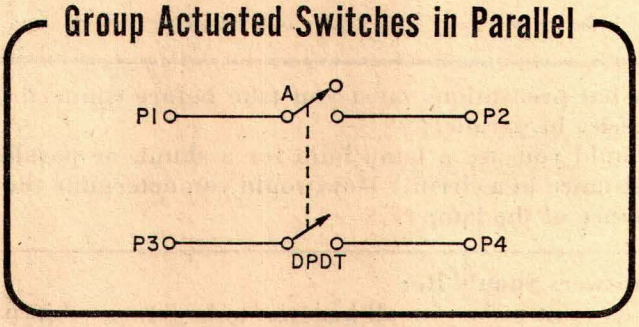
(d) $P_1 = 0.5 \times 6 =$ *3 watts*; $P_2 = 0.2 \times 6 =$ *1.2 watts*; $P_3 = 0.15 \times 6 =$ *0.9 watt*; $P_T = 0.085 \times 6 =$ *5.1 watts.*

Switches in Parallel—Switches are connected in series in some cases and in parallel in others.

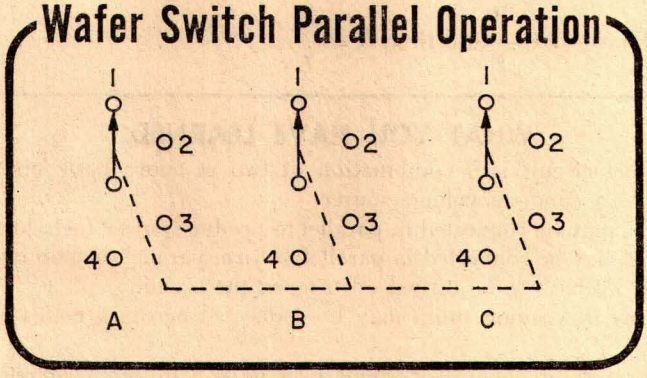
As can be seen in the figure above, right, switches can form a closed-circuit condition from P_1 to P_2 if either one or the other or both are closed. To



obtain an open circuit from P_1 to P_2, both switches must be open. Another form of the parallel switch is the type which has two or more poles actuated by the same mechanical element.



The dashed line indicates that the two poles of the switch are actuated at the same time.

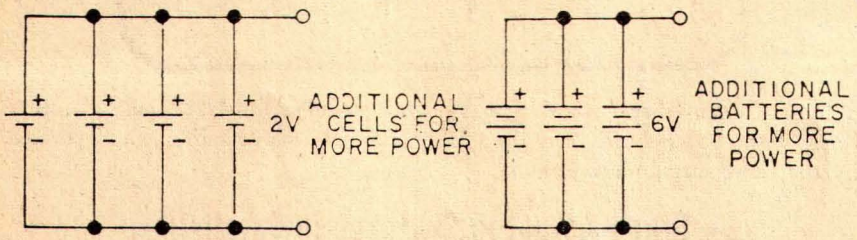


The rotary action available in the application of the wafer switch permits many parallel operations. In the illustration above, the switch has three wafers (A, B and C). Again, the dashed line represents mechanical connec-

tion whereby all wafers are actuated at the same time. In this case the switch is said to be a *three-* (triple) *pole, quadruple-throw* (four position), or *TPQT* (triple-pole, quadruple-throw).

Batteries in Parallel—For heavy-duty operation, batteries of equal voltage are constructed with plates in parallel or connected with many cells in parallel. This means they require more charging current to become fully charged. Yet, in another sense, more current must be drawn to cause the batteries to be discharged.

Batteries in Parallel



Q10. What precautions must you take before connecting batteries in parallel?

Q11. Could you use a lamp bulb for a shunt, or parallel, resistance in a circuit? How would you determine the resistance of the lamp?

Your Answers Should Be:

A10. You must make sure all batteries to be connected in parallel have *the same voltage.*

A11. *Yes,* you could use a lamp for a shunt in a circuit. The wattage and voltage ratings permit you to calculate the resistance. That is, $I = \frac{P}{E}$ and then $R = \frac{E}{I}$.

WHAT YOU HAVE LEARNED

1. A parallel circuit is a combination of two or more basic circuits connected to a common voltage source.
2. Batteries may be connected in parallel to produce power for a longer time.
3. Switches may be connected in parallel to form parallel turn-on operations; yet they all have to be turned off to open the circuit.
4. Filaments in vacuum tubes may be connected across a common voltage source.
5. Each branch of a parallel circuit may have a different current flowing through it. All branches will have the same voltage applied.
6. To find the total current in a parallel circuit, you determine the sum of all the branch currents.

(Continued on page 110)

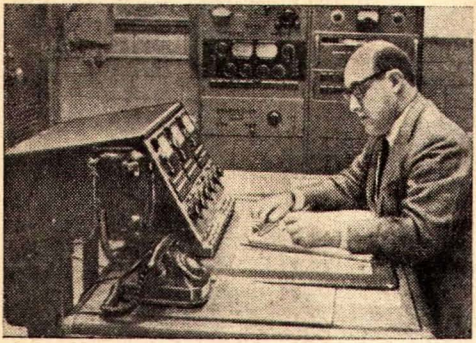
Absentee Sit-In

Mohammed can't go
to the mountain?
Then send mountain
to Mohammed
—and pronto!

■ High-school students in the Greater New York area are now offered a helping hand found in few other places in the world. The hand, in this case, takes the form of a special FM radio station. Its purpose: to enable physically handicapped students to continue their education even though they can't go to school. What's more, there's even a special telephone system that lets students and instructors communicate with each other al-

Instructor receives question from student at left, then files it with other queries.

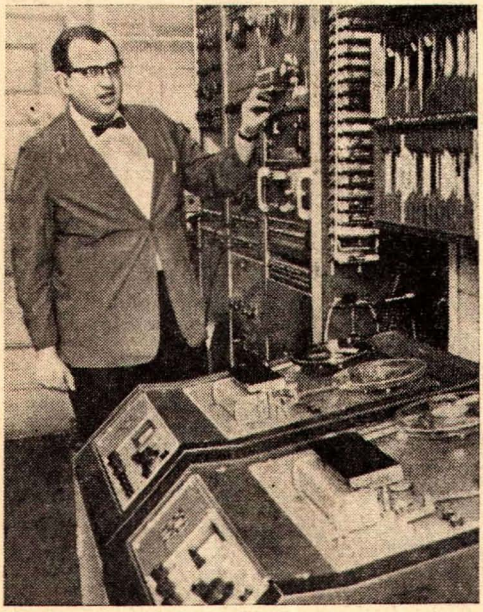
Homebound student calls in question to his instructor over special telephone system.



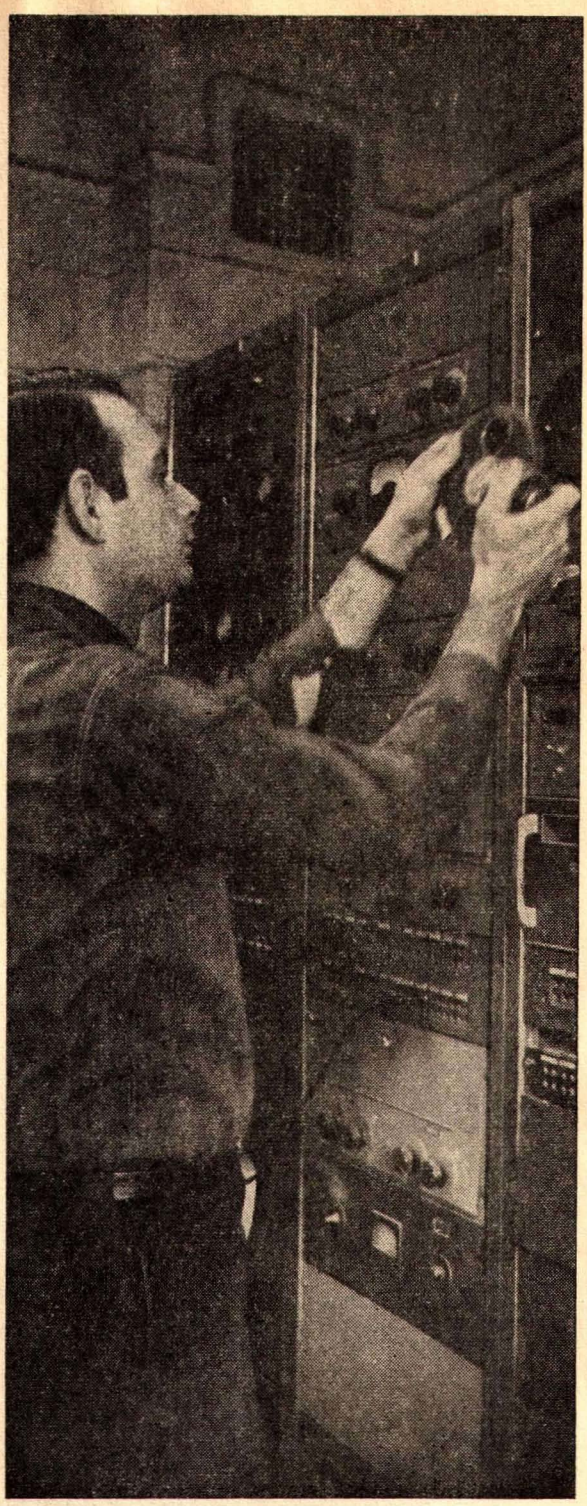
Technician supervises equipment which broadcasts High School of the Air programs.

most as though they were in the same room.

Students who are participants in Homebound Instruction, a program for students who are unable to attend school because of permanent or temporary physical handicaps, are supplementing their education by means of High School of the Air. This special FM radio station, which has been set up to broadcast educational programs for the homebound student, helps him keep pace with his schoolmates and then prepares him for his



Tapes and tape recorders play important role in station's programming. Machines in foreground are professional RCA units.



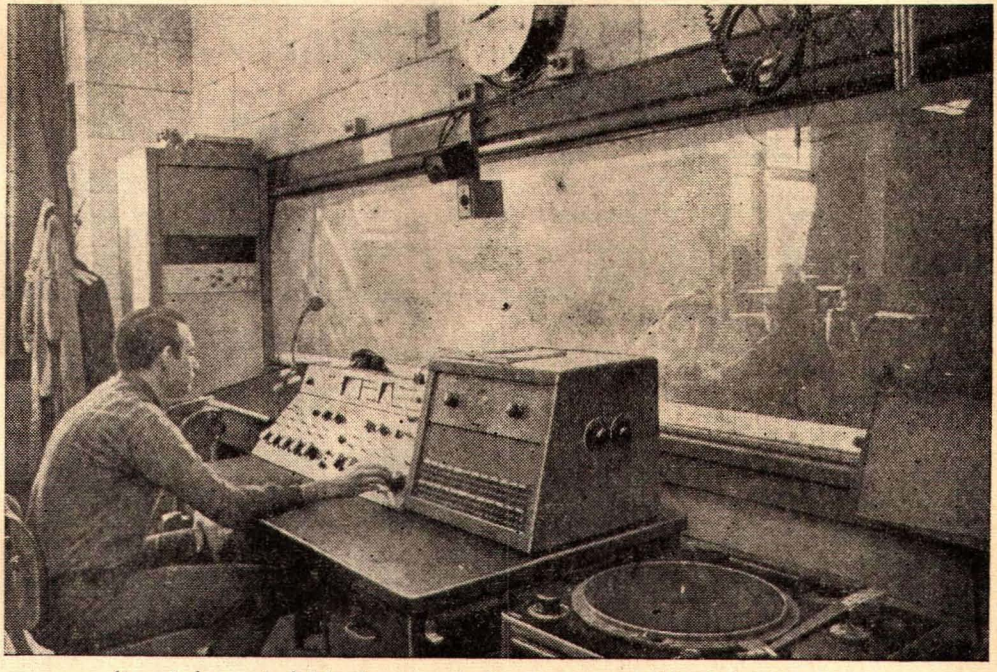
Getting ready to record High School of the Air program, station technician loads tape on recorder mounted in large rack panel.

In studio, students and instructor participate in High School of the Air round-table discussion, which is broadcast to homebound students who are physically unable to attend classes.

Regents and College Board Examinations.

As part of Homebound Instruction, a program which brings teachers to the students' homes for regular two-hour sessions, High School of the Air is a combination radio station and school. While students at the station participate in regular classes, Homebound students listen to the classes and communicate with their instructors via a telephone broadcasting system. This free-flowing dialogue between instructor and Homebound students enables their teachers to answer questions as well as quiz their absentee students.

Safeguarding the handicapped student from an irretrievable academic set-back, High School of the Air ensures that the high-schooler will receive a well-rounded, college preparatory education despite his accident or illness. —*Robert Levine* ■



In control room, technician keeps eye on discussion group and hand on gain control as broadcast goes out over airwaves. Some class sessions are taped for later broadcast.

DID YOU HEAR THAT STAR?

By Alan C. Van Dine

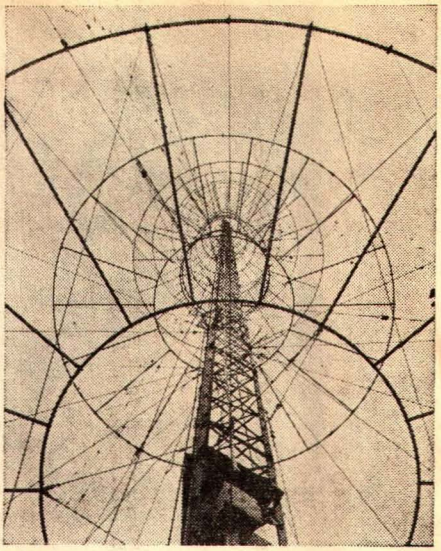
■ Paul Kilborn looked up from his latest copy of *Playboy* and out through the screen of his porch, 300 feet up the side of a West Virginia mountain. In the valley, lights were flashing on, first in the office building, then in the equipment sheds of the big Green Bank observatory. Paul stepped quickly inside and dialed the main office.

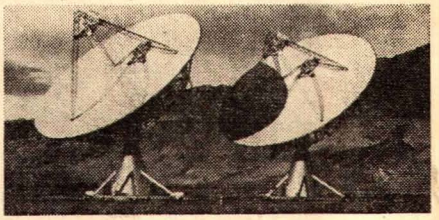
"What's going on down there?"

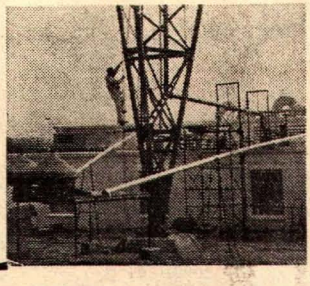
"We're not sure, sir." It was one of the new technicians assigned to the National Observatory since its 1967 expansion. "We don't know what it is, but we're getting a signal. A pattern."

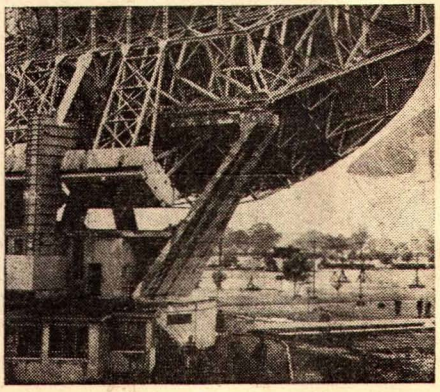
The *Playboy* still in his hand, Paul headed for the station wagon standing in the driveway, its engine still warm. Project Sensor was less than twenty hours old, and already the false alarms were starting. What would it be this time: a ham operator, trespassing on the radio-restricted zone? A distant thunderstorm? A stray transmission from an airline flight?

Theoretically, the antenna was tracking the star Tau Ceti, eleven light years from Earth. But Paul knew to expect surprises. He had helped to redesign the big radio telescope with a new narrow beam antenna and low noise receivers that might pick up almost anything. He found Dr. Gerard in the computer analysis room, wrist deep in readout sheets and frowning.









"Any inkling, Jake?"

"None," said the project director, "except that it's too good to be true."

Paul looked at the pulse pattern, traced out on long grid sheets. "Much too good," he agreed. "It looks almost like a musical score."

"Right," Gerard said. "The Tau Ceti *Toccata and Fugue*. Only it will turn out to be a jamboree from some jerkwater radio station with a faulty transmitter. Wouldn't that look good in the newspapers? *Scientists find intelligent life in West Virginia!*"

Paul glanced at another sheet, then another. More of the same. "When did it start, Jake?"

Gerard checked the timing blips. "Zero one thirteen, and it's still repeating. I thought we might have some weird oscillation in the frequency analyzer, but all circuits check perfectly. The interference analysis crew can't find a thing that resembles this. We played it for the Navy hotshots at Sugar Grove, and they can't identify it either."

Paul squinted at the azimuth and elevation dials. "We can't have drifted off Tau Ceti."

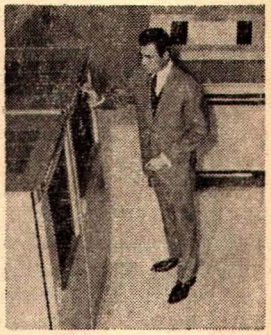
"Not a chance. She's tracking that star steady as a rock. But this signal is much too strong to be coming from the star. Another thing—look at this frequency analysis. The rhythmic signal is superimposed *over* the random noise we were getting from Tau Ceti. Figure that out."

By 3:30 the Sensor team had exhausted every plausible radio source anyone could suggest. No malfunctions apparent. No stray transmissions from outside the valley. But the signal continued: a repeating pattern of four sequences that defied all attempts at decoding. Could it be coming from the Tau Ceti solar system after all? The first real sign of intelligence in deep space? Paul and Dr. Gerard decided to check it out. They steered the antenna off the star.

The signal stopped. For a full minute, not a word passed. Pointlessly, Gerard walked to the visual telescope and peered through, as if to look at the distant radio transmitter that had just materialized in the mind of everyone in the room.

"It can't be," he muttered. "It just can't be."



"Maybe not," Paul said, "but it's what we're here to find."

"It's too distinct," Gerard insisted. "The signal is simply too strong. Where would they get that kind of power?"

"And too complicated," Paul added. "Like a melody, or a series of equations. If they were putting out a beacon signal, it would be something simple and basic, like two plus two equals four." *(Continued overleaf)*

Gerard nodded. "Let's try it again."

"Wait a minute," Paul said. "Let's try another target instead." The vague beginnings of an idea were assembling in his mind, but it was too far fetched, and he was too tired . . . he turned his attention back to the antenna controls.

When a second star was zeroed in, the signal resumed—the same pattern—and now all attempts at explanation were in ruins. How could two solar systems, light years apart, be beaming the same message? Gerard called a break for coffee and rest.

Paul, who had been awake for nearly 24 hours when the signal began, now found that he couldn't sleep. Lying on the couch in Gerard's office, he reopened his *Playboy* and thumbed through it.

Gerard, leaning far back in his swivel chair, reached for his cigarettes, started to offer one to Paul, then noticed the magazine.

"Tell me," he said. "Why is it that every time I'm up to my eyelashes in trouble, I find that my top assistant has buried himself in some girlie mag."

"It's envy," Paul said. "A lover looks at a star, and it reminds him of peace, wisdom, and womanhood, which reminds him of his girl. So he tells the star how nice his girl is, and he tells the girl how nice the star is. *We* look at a star and promptly get hung up on electromagnetic frequency analysis. I'd rather be a lover."

"I may cry," Gerard said. "And you, if you happen to get around to it, might try saying something even *half* that smart about radio transmissions from the direction of Tau Ceti."

"Oh, that. Well you see, if we were lovers and poets, the whole thing would be quite simple. We would know immediately that our friend is writing poetry."

"Which friend? Tau Ceti?"

Paul hesitated. "No, not the star. The antenna. It has noticed its first celestial object and reacted like most of our new equipment reacts—temperamentally."

Gerard grunted.

"Think about it," Paul said. "We have put 203 million dollars worth of sharpened perception into this thing, haven't we? And we have it so cross-rigged with computers that we're not even sure we've isolated all of the functions. Right?"

"Right," said Gerard, "except that not even in our most imaginative blundering could we *accidentally* program our computers to write poetry."

"No, no . . . not program. But we *have* hooked the antenna into so much redundant circuitry that the damn thing could practically talk to itself. And the antenna can eavesdrop on stimuli that we haven't even discovered. That's what it's for, isn't it?"

"Okay, okay." Gerard was apparently tiring of the game. "Sensitivity, brains, and a celestial viewpoint. It all adds up to a poet. A 15-acre, 203 million dollar federal poet. Go to sleep!"

Paul shrugged. Sleep, to be sure, was the only solution, and he could finally feel it coming. But Gerard sat up suddenly, grinning.

"I just realized something," he said. "We have a whole roomful of eager young astronomers, physicists, and mathematicians downstairs without a thing to do. Paul, can you think of a more gullible group in all this world than astronomers, physicists, and mathematicians?"

"Not offhand."

Gerard reached for the phone. "Well, since you have come up with the original hypothesis of the night, I suggest we unleash all that Ivy League tuition on testing it. It might be just what we need to get some of those high-priced brains in motion."

A half-awake Princeton mathematician named Pitts was Gerard's choice as project chief for the exercise. The young man stared uncertainly through hanging strands of hair as his boss explained the assignment.

"This is right down your alley, Pitts. Besides, I've always admired your beard. I want you to have everyone who's awake take another crack at decoding the signal pattern, but with two arbitrary assumptions: first, that it translates to meaningful English; second, that it follows a regular meter, like poetry."

"Dr. Gerard, may I point out . . ."

"Pitts," Gerard interrupted, "you are far too bright to go walking around a place like this with a closed mind."

Pitts left. Paul finally slept, but Gerard shook him just before sunrise to say that he had called Pitts to come back and discuss his progress.

"You could have gone down to the control room, you know," Paul yawned. "Supplied some encouragement, a few suggestions. *(Continued on page 106)*

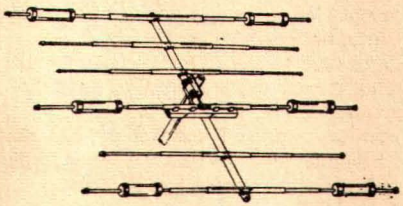
Hey, Look Me Over . . .

Continued from page 21

directly from the controls on the front panel. A special matching switch allows you to compare or match sets of transistors. The Model 443 features all silicon solid-state printed circuit board construction and dual transformers for isolation and safety. Other features include a flashing light to indicate presence of high voltage on the diode test terminals, built-in oscilloscope voltage calibrators, and terminals for connecting external test sockets. The 443 transistor-diode curve tracer is available in kit form at $69.95 and factory-assembled at $99.95. For further information write EICO Electronic Instrument Co., Inc., 283 Malta St., Brooklyn, N. Y. 11207.

New Amateur Sky Hook

Mosley Electronics has come out with a new addition to their Trap-Master line of amateur radio antennas. This one is called Classic 36, a 6-element tri-band beam, rated for maximum legal power on 10, 15, and 20

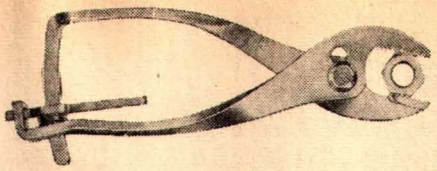


Mosley Classic 36 Amateur Radio Antenna

meters. Features the Classic coax-fed balanced element, and the Mosley Trap-Master, making it weather- and dirt-proof for frequency stability under all weather conditions. Hardware is of stainless steel, and maximum element length is 29 ft. 3 in. Weight is 69 lb.; price $171.92. Get more info from Mosley Electronics, Inc., 4610 N. Lindbergh Blvd., Bridgeton, Mo. 63042.

Pliers with Pizazz

The Sta-Tite Corp. calls these automatic locking pliers Lock-Matic. The tool is 7½ in. long and does the work of an adjustable wrench, clamp, or gripping tool, in addition to performing as pliers. Its two-position slip joint jaws open from zero to ⅞ of an inch with locking action and to an inch and a quarter for use as pliers. Lock-Matic pliers are made of heat-treated steel with a chrome



Sta-Tite Automatic Locking Pliers

finish, and they will hold objects with pressures ranging from a fraction of an ounce to 1000 lb. Price is $3.98 and you can get more info from Sta-Tite Corp., 3900 Louisiana Circle, St. Louis Park, Minn. 55426.

Pencil in that Design

A slim, 3-oz. instant heat pencil iron that will do the work of much heavier pistol-type guns has been brought out by Wall Mfg. as their Model IDL. Its slimness came about by using a dual heat element controlled by a thermal time delay relay, nixing the need for a transformer. When a switch on the handle is depressed, a high-wattage element brings the tip temperature up to operating heat in seconds. The relay then cuts in a lower wattage element that maintains the proper soldering heat with no danger of overheating. It continues at the lower wattage until a higher heat is required, then the relay cuts in again for as long as needed. Initial input is 180 watts and it operates at 40 watts. Heating elements may be changed without tools. Iron-plated or ⅛-in. plug-in tips are inserted by loosening one set screw, and you can match the tip to your job. Price is $9.95 and more dope can be had from Wall Manufacturing Co., Kinston, N. C. 28501.

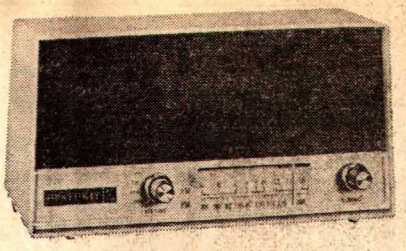
(*Continued on next page*)

Wall Soldering Pencil

Continued from previous page

Neat Lil Radio

Heath Company has brought out a solid-state AM/FM table radio, the GR-48, a bargain at $39.95 in kit form. The GR-48 has switchable automatic frequency control (AFC) and 5-μV sensitivity. Automatic gain control on AM keeps the volume constant under varying signal strengths. There are built-in AM and FM antennas. The cabinet is avocado green with a color-coordinated grille. The dial is back lighted and all controls are front-panel mounted. There's a 3 x 5-in. oval speaker. The circuit goes together on a single circuit board, and the AM/FM tuner is supplied pre-assembled and factory-aligned.



Heathkit GR-48 Table Radio

Want to know more about the GR-48? Then drop a line to Heath Co., Benton Harbor, Mich. 49022.

Newscan

Continued from page 14

can instantaneously display locations of a fleet of tractors and trailers—has been designed by Philco-Ford for Americas trucking industry. The electronic central dispatch is a new feature of Philco-Ford's Fast Freighter System, a modern tool of the motor freight industry that combines inter-terminal communications with data processing for immediate information needs of a motor freight company.

Not only does Fast Freighter tie a motor freight company's terminals together into a modern communications network, it also brings to each terminal manager the computer power he needs for a variety of tasks, from figuring way bills, to making out his payroll, or even to computing efficiency of his tractors' performance.

In a simple presentation, Philco-Ford personnel demonstrated to the Editor how the electronic central dispatch enables a terminal manager to obtain information instantaneously on inbound or outbound shipments, tractor and trailer use, and the status of each freight terminal in a motor freight system.

The central dispatch located anywhere is connected over common telephone lines to a Fast Freighter central processor at Philco-Ford's Willow Grove, Pa., engineering center.

The electronic central dispatch appears as a TV set mated to an electric typewriter keyboard. It features a TV-like screen on which computer-derived information is displayed in plain English or in graphic form.

The terminal manager uses the electric keyboard to compose messages or to request information from the central Fast Freighter processor. When he composes his message, it appears simultaneously on the TV screen, giving him a chance to check its accuracy before dispatching it over a telephone line to the central processor.

When the message is received at headquarters, Fast Freighter updates all relevant records. As a result, terminal managers can maintain a continuous check on shipments either inbound or outbound from their terminals—avoiding cumbersome use of wall maps and the high cost of long-distance telephoning.

With instantaneous communications and continually updated central information records, motor freight managers have, through Fast Freighter, a continually fresh and up-to-the-minute picture of their operations and resources. ■

Hear That Star?

Continued from page 104

"No need," said Gerard. "I have one crew running a complete recheck of all equipment while Pitts and his boys play anagrams with your new theory of versified astronomy. Besides, if I went down there Pitts might start asking questions, and then what would I say?"

Pitts came in, tight-lipped and plainly annoyed, clutching a scrap of notebook paper in his right hand. He looked like he thought the sky was falling.

"We have two complete words, and the rest is falling into place quite rapidly," he told Gerard. "But I'm afraid the staff is a little upset."

Paul looked quickly at Gerard, then jerked the sheet from the young man's hand; and he and Gerard read it together. It said, "Twinkle, twinkle . . ." ■

Identify Stations

Continued from page 68

station on 647 khz at 0401 with news, I think in English. At 0407 what appeared to be the Rhodesian jamming became audible, but it was not as clear as on Feb. 20".

"Can you tell me if the S/On time corresponds with Francistown's, whether the jamming heard on 647 corresponds with Rhodesia's on this frequency, and whether the Francistown station was still on the air March 11???"

To which the answer came back loud and clear:

"You are quite correct in thinking that we are now doing programs to Rhodesia. . . . Regarding Francistown's sign on at 0400, it was on the schedule as a 'Note 1' start, which consists of bow bells, followed by announcements, the length of the announcements is variable, so it is quite possible that the sign on was at 0358. . . . The jamming you heard was undoubtedly from Rhodesia, as it had a very distinctive note. The station was still on the air when you listened. Its closing date is something of a mystery."

Whenever a distant radio listener can get his ID checked out in this kind of candid manner, he's got it made.

The Space Age. When logging satellites, probes headed for the Moon and Mars, etc., it is even more important that your ID be checked by someone "in the know." When logging space signals, except for most manned missions, all one ever hears is "sounds." And until your description of this modulation, along with time and date of reception, can be confirmed by an official source, all such loggings must be categorized as tentative.

Unfortunately, it's becoming increasingly difficult to obtain this information. During the first three years of the satellite era, both the Soviet Academy of Science (through R. Moscow) and a member of the Voice of America's staff (who was himself interested in space monitoring) provided DXers with such services. But as the novelty wore off, both SWBC giants eventually discontinued the practice. Today, though both the U.S.S.R. and the U.S. each maintain official "no space QSL" policies, one can still get someone from an appropriate agency to check, unofficially, the ID of a space vehicle heard. ■

Signal Tracing Gun

Continued from page 59

switch turned *on* and sensitivity control set at minimum. A strong audio signal should raise current drain to 24 mA. Also check capacitors and the diode connected to the probes and double-check the hook-up of circuit board and connections to it, as well as all of the components. After making corrections, if any errors are revealed by check-up steps mentioned above, and the unit still does not work, you undoubtedly have a defective IC and will have to replace it.

Once the unit is working, fasten the remaining cover into position over the cut-out with wood screws and you have completed a construction project that will provide you with a useful piece of test gear for your shop or lab.

Hints on Using It. The top probe is used for checking RF and IF sections of a receiver or transmitter; the bottom one is used to check audio circuits. To trace a signal, start from the final output stage and work towards the input. Once you hear a signal in the speaker of the tracer, you've reached the point in the circuit that is functioning. All stages that follow from this point on to the final output are not getting the signal. In all probability, your trouble will be found in the next stage or stages immediately following the point where you are first able to receive a signal. Once the point where the signal is stopped has been located, check that circuit for a defective tube, transistor, or other component, or for a loose connection or cold solder joint.

The sensitivity control must be raised to near maximum to detect weak RF or audio signals. As you move nearer the input source you reduce the strength of the signal and may have to raise your sensitivity control proportionately to detect the presence of a signal. Be sure the ground lead of your signal tracer is clipped to the chassis whenever tracing signals. Also, keep one hand in your pocket when near high-voltage circuits. ■

The Islands That Aren't

Continued from page 80

proaches Sealand is quite literally fired upon. But frequencies supposedly under consideration are 764, 1034, and 1502 kHz.

'Portable' Islands. Though off-shore oil and gas drilling rigs can be moved from place to place (the one in our photo is on its way through the Welland Canal), while in operation they are just as securely attached to the ocean floor as those ancient anti-aircraft fortresses. And this type of artificial island is considerably easier to hear in North America, since they often work the various Gulf and Pacific Coast marine telephone operators in the 2-MHz band. They're in there with the shrimp boats.

Off-shore mineral rights are often the subject of far more serious international disputes than off-shore broadcasters. While the major powers will tolerate, for a time at least, the use of man-made islands for pirate radio stations or even gambling casinos, they won't put up with anyone pirating natural resources from those hunks of ocean floor which they claim as their own.

The difficulty is that no one agrees exactly whose sovereignty ends where. Most of the Earth's larger nations claim off-shore mineral rights out to the edge of the continental shelf—often a 100 miles or more. At the opposite end of this scale a majority of the small and underdeveloped countries want everything beyond 12 miles under UN control—which would hit U.S. interests especially hard in the Gulf of Mexico. As luck would have it, artificial islands in the Gulf for most readers will be the easiest of all to hear. Watch for them at night working the New Orleans Marine (telephone) operator on 2382 or 2206 kHz, and Galveston on 2134 kHz.

Depending on the sunspot count, they will often be heard at great distances during daylight hours on the 30.56-30.84 MHz industrial band covered by many SW receivers. Narrow-band FM is used up here, but you'll be able to make out what is being said by tuning slightly to one side of the carrier frequency.

Prospects. With the important exception of top-secret underwater submarine tracking stations, the military use of man-made islands is rapidly becoming a thing of the past. Former anti-aircraft fortresses are now only of value to pirate broadcasters and gamblers. And with the advent of highly sophisticated airborne radar and satellite-based surveillance systems, there's probably not much future for conventional off-shore radar installations. However, Washington still operates three so-called "Texas towers" off the East coast and you might be able to catch them using non-tactical IDs on 2716 kHz.

But clearly the future of DX from artificial islands is mostly linked with man's quest for those riches to be found at the bottom of the sea. And as the Earth's natural resources dwindle while undersea technology advances, this brand of DX promises to become even hotter than that current concern over "Sealand." ■

SonoPulse Timer

Continued from page 49

We purposely have not specified the length of the pair of wires between the switch and SonoPulse. Make it a convenient-to-use length. You may use zip cord, 2-conductor jacketed cable, or twisted hook-up wire. If you use a double-pole switch in place of the single pole, the extra contacts can be used to turn *on* or *off* the enlarger or device being timed. You can best see this technical point by referring to the schematic diagram.

Using SonoPulse. When completed you will hear a pleasant beep tone burst, repeated continuously as long as switch S1 is closed. The repetition rate is controlled by potentiometer R3. The fastest pulse rate is attained at full counter-clockwise (minimum resistance) rotation of R3; the slowest is full clockwise (maximum resistance) rotation.

We did not take the time to locate calibration points on our model. You will find the SonoPulse timer more useful if you do calibrate the control. This can be done easily by using a stop-watch. Just start the watch at the beginning of a count of 10 (or 20 if you prefer) beeps and stop it at the end of the count. Divide the total elapsed time registered on the stopwatch by the number of beeps counted (10 or 20) to arrive at the time duration between beeps. These various settings of R3 at the time the count is made will become your calibration marks. ■

The Unicorn

Continued from page 42

put meter to measure the output level. However, if one is not available, trust the judgment of your ears.

After peaking T1, remove the temporary jumper from C3B and set the tuning capacitor at the midpoint of its rotation. Adjust the signal generator to produce an output signal at 1000 kHz and feed the signal, loosely coupled, to the antenna post (J1).

Adjust the tuning slug of the receiver's oscillator coil (L2) until you get output at the speaker. Then adjust the trimmer capacitor on C3B for maximum signal output.

Without making any change in the setting of the signal generator, adjust the trimmer capacitor on the RF section of the tuning capacitor (C3A) for maximum output at the speaker. Also, adjust the tuning slug of the antenna coil (L1) for maximum output. Now go back and do it again—you'll hear the improvement.

Before changing the position of the rotor of the ganged tuning capacitor, place a mark on the panel to identify this position as a reference point when adding markings to the dial plate.

Calibrating the Dial. Set the signal generator first at 550 kHz and then at 700, 900, 1200, 1400, and 1700 kHz successively and tune the dial of the receiver for maximum signal at each of these frequencies, marking the spots of maximum signal for each frequency, to be used for the calibration points of the dial.

For Your Listening Pleasure. Disconnect the signal generator and connnect a 10-ft. indoor antenna (a 10-ft. length of hookup wire stretched out will do) to J1. Tune the receiver to a broadcast station, set the volume control so that the station is just audible and touch up all tuning slugs and trimmers of the RF section of the receiver for maximum volume. You may find a slight readjustment of the IF transformer (T1) and oscillator coil (L2) tuning slugs and also the trimmer of the oscillator portion of the tuning capacitor (C3B) at this point may improve the output. Now sit back and listen to your heart's content. ■

South of the Border

Continued from page 38

pay for our broadcast, God will bless you. Enclose your tithe, a little offering, a donation, whatever the Lord lays on your heart, and we will thank you, thank you, thank you from the bottom of our heart. God will bless you. Don't let me worry about finances. Send your donation now. . . ."

No one knows just how much the *schlock*-ministers take in from their radio pitches, but some have been spending as much as $6,000 a month to advertise over XERF.

The Future. There are signs that the gold in them thar religious hills may soon be running out. Because of patterns of interference that have developed recently as other powerful stations have gone on the air in Canada, XERF is planning a new 500,000-watt transmitter, and has already bought the land on which to build it. To go with this new potency, non-owner Gonzales seems to be seeking a new image, and has made approaches to CBS as well as to Mexican broadcasters, with an eye to gaining some sort of reputable network affiliation. If he brings it off, one of the world's most powerful stations may become just another music-and-news outlet. If he fails, untold new millions will soon be exposed for the first time to the wonders of fake diamonds, cure-alls and evangelical hustlers. ■

The Third Hand

Continued from page 71

to match for your standard, proceed as follows: Externally connect R1 to the clip leads, as shown in the calibration schematic and adjust the calibration resistor (Rc) until the VOM or other standard reads exactly 1 mA. The meter of the Third Hand should also read exactly 1 mA. If it doesn't, but is very close to that value, substitute another 220 ohm resistor in place of the one first used, which had been temporarily clipped into the circuit. The reason for this exchange is that, in all probability, each of the 220 ohm resistors you try will have a slightly different value and by the variation in the value within the 5% tolerance of that specified, you may, in the exchange, find one that is just the right value to trim the meter reading so that it coincides with your standard meter. You may find you will have to try two resistors of lower value connected in series, to total the 220 ohms, in order to take advantage of their individual variations from specified value to trim the meter shunt to the exact resistance needed. Repeat this process for each of the three shunts in the Third Hand. Once you arrive at the correct resistor combinations, remove the clip leads and calibrating resistor Rc, and connect the corrected resistors into the circuit permanently. From this point on your Third Hand is ready to use on virtually any of your new projects.

The capacitance of C1 should be as large as possible and still permit mounting it inside the meter case. The 300uF capacitance specified in the Parts List is the absolute minimum recommended. The capacitor should be rated at least 6V working voltage, but, preferably higher.

Selecting The Fuse. The rate of speed at which the fuse blows, which is really the safety factor for protecting the solid-state components, is directly related to the rating of the fuse. Selecting a fuse that will just hold the circuit under test and still pass the proper current for the transistors or diode will provide much faster circuit opening blow protection than a fuse that can pass much more current than that required for the circuit. For example, if you are building a solid-state unit that draws 1.0 mA you could protect it with a fuse rated at 1/500A. Or, if your unit draws 5.0 mA you would protect it with a fuse rated at 1/200A.

There are fuses manufactured that react faster than the 8AG type, however, they are not normally available from parts houses. Since the 8AG's response time is fast enough to protect all but the most delicate instruments it is a good compromise for the experimenter. Just remember, use a fuse that is capable of just passing the required current for the circuit for maximum protection. ■

e/e Basic Course

Continued from page 98

$$I_T = I_1 + I_2 + I_3 + \ldots$$

7. To find the total resistance of a parallel circuit, divide the applied voltage by the total current in the circuit.

$$R_T = \frac{E}{I_T}$$

8. If the resistance is the only factor known, you may use any value for E that permits simple arithmetic operations for determining the current in each branch. After the total current has been computed, the same value for E must be used to determine total resistance.

This series is based on material appearing in Vol. 2 of the 5-volume set, BASIC ELECTRICITY/ELECTRONICS, published by Howard W. Sams & Co., Inc. @ $19.95. For information on the complete set, write the publisher at 4300 West 62nd St., Indianapolis, Ind. 46268.

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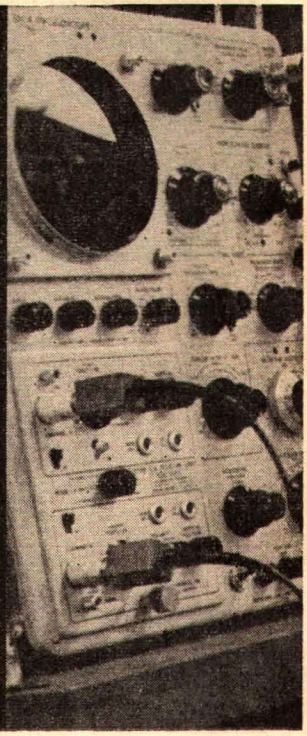

In today's electronics boom the demand for men with technical education is far greater than the supply of graduate engineers. Thousands of real engineering jobs are being filled by men without engineering degrees—provided they are thoroughly trained in basic electronic theory and modern application. The pay is good, the future is bright... and the training can now be acquired at home—on your own time.

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But you do need to know more than soldering connections, testing circuits and replacing components. You need to really know the fundamentals of electronics.

How can you pick up this necessary knowledge? Many of today's non-degree engineers learned their electronics at home. In fact, some authorities feel that a home study course is the *best* way. *Popular Electronics* said:

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