JANUARY / FEBRUARY 1972

Fifty Cents

Electronics Digest

BIOGRAPHY • HISTORY • NEWS • BASIC ELECTRONICS

CAR 54, WE SEE YOU . . .

In This Issue . . .

Sub makes trip through big pipe under mountain

•

New alarm system hits pollution

•

New automated freeway system

•

Defenses posed to sub-launched missile threats

•

New device cuts x-ray exposure

•

Navy destroyers get computerized command-control

•

Expo in Houston for N.E.W.

•

Today's radio is a better buy

•

Old-Time Radio T.M.

See Cover Story, Page 3

SCIENCE PROJECTS

HISTORICAL EVENTS IN ELECTRONICS

World Radio History

When's the last time you got goose bumps when they played the Star-Spangled Banner?

It's been a while, right?

Well, then you're like a lot of us.

It seems that many of us are too grown-up to get excited about things like the Star-Spangled Banner any more.

You could almost say that patriotism makes us feel embarrassed.

Besides, it's hard to really feel patriotic when you hear so much about how this country is falling apart.

But, of course, America still has a Bill of Rights.

And free elections.

An incredibly high standard of living.

And a free enterprise system that lets you hitch your wagon to any star you want.

And plenty of other things you can't find anywhere else in this world.

Know what? Looking at it that way, America deserves a lot more credit than it's been getting.

One of the best ways to give this country the support it deserves is to buy U. S. Savings Bonds.

They strengthen the country so that it's better prepared to solve its problems.

And they happen to be one of the best ways to provide for your *own* welfare.

The interest is exempt from state and local income taxes. And you don't have to pay Federal tax until you cash your Bonds.

Buy U. S. Savings Bonds through the Payroll Savings Plan where you work. Or at your bank.

It'll give you a good feeling.

And a perfect excuse for getting goose bumps the next time they play the Star-Spangled Banner.

If they're lost, stolen, or destroyed, we replace 'em.

Take stock in America

Buy U.S. Savings Bonds

The U.S. Government does not pay for this advertisement. It is presented as a public service in cooperation with The Department of the Treasury and The Advertising Council.

World Radio History

Electronics Digest

THE ELECTRONICS MAGAZINE FOR HOME AND SCHOOL

Volume Five / Number Four January/February 1972

FEATURE ARTICLES

DEPARTMENTS

William M. Palmer, W5SFE
Editor

Vicky C. Owens, *Production Graphics* Arthur Trauffer, *Contributing Editor*

Electronics Digest

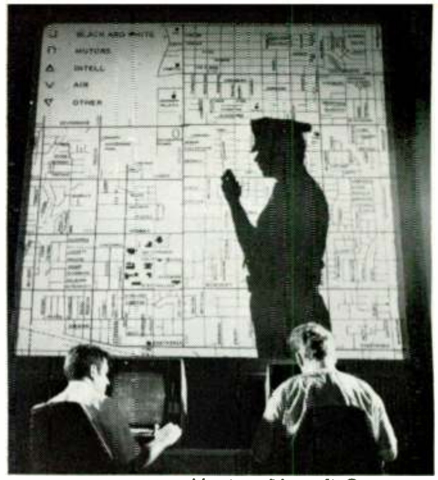
ADVERTISING / EDITORIAL OFFICES
1024 Currie Street, Fort Worth, TX 76107
(817) 332-3825

SUBSCRIPTION SERVICE: Address subscription orders and inquiries to Subscription Service, Electronics Digest, P. O. Box 9108, Fort Worth, TX 76107.

EDITORIAL CONTRIBUTIONS: All material must be accompanied by return postage and will be handled with reasonable care, however, publisher assumes no responsibility for return or safety of artwork, photographs, or manuscripts. Inquiry should be made prior to submitting manuscripts for publication.

ELECTRONICS DIGEST, January/February 1972 (Volume 5, Number 4). Published bimonthly at (new address) 1024 Currie Street, Fort Worth, Texas 76107, U.S.A., by Electronics Digest Periodicals, Inc. Contents copyright 1972 by Electronics Digest Periodicals, Inc. All rights reserved. Annual subscription rate is $2.50 (6 issues) in the United States and possessions, Canada and Mexico. All other countries $4.00 annually. Second Class postage paid at Fort Worth, Texas.

PRINTED IN THE UNITED STATES OF AMERICA



Hughes Aircraft Company

CAR 54, WE CAN SEE YOU – So say engineers operating a prototype automated electronic display developed as a law enforcement aid by Hughes Aircraft Company, Fullerton, Calif. The display is part of a demonstration system designed by Hughes to show how automation and other "spin-off" technologies of the aerospace industry can assist police in handling routine operations and civil emergencies.

Hughes Aircraft Company

SPACE-AGE POLICE – A prototype automated electronic display, developed by Hughes Aircraft Company, Fullerton, Calif., as part of a demonstration system to show how aerospace "spin-off" technologies can assist police in handling routine operations or civil emergencies is operated by Police Chief David Michel (left) of Anaheim, Calif. Don Vogelsang (right), Hughes project manager for law enforcement systems, explains how systems engineering techniques were applied to a design study for an Improved Emergency Communications System under contract to the City of Los Angeles, which has applied for a $4.5 million Federal grant for first-year implementation of the plan. Chief Michel was host to the 78th annual conference of the International Association of Chiefs of Police at Anaheim, Calif., September 25-30, where Hughes officals explained to police chiefs from more than 60 nations its systems integration concept for law enforcement.

World Radio History

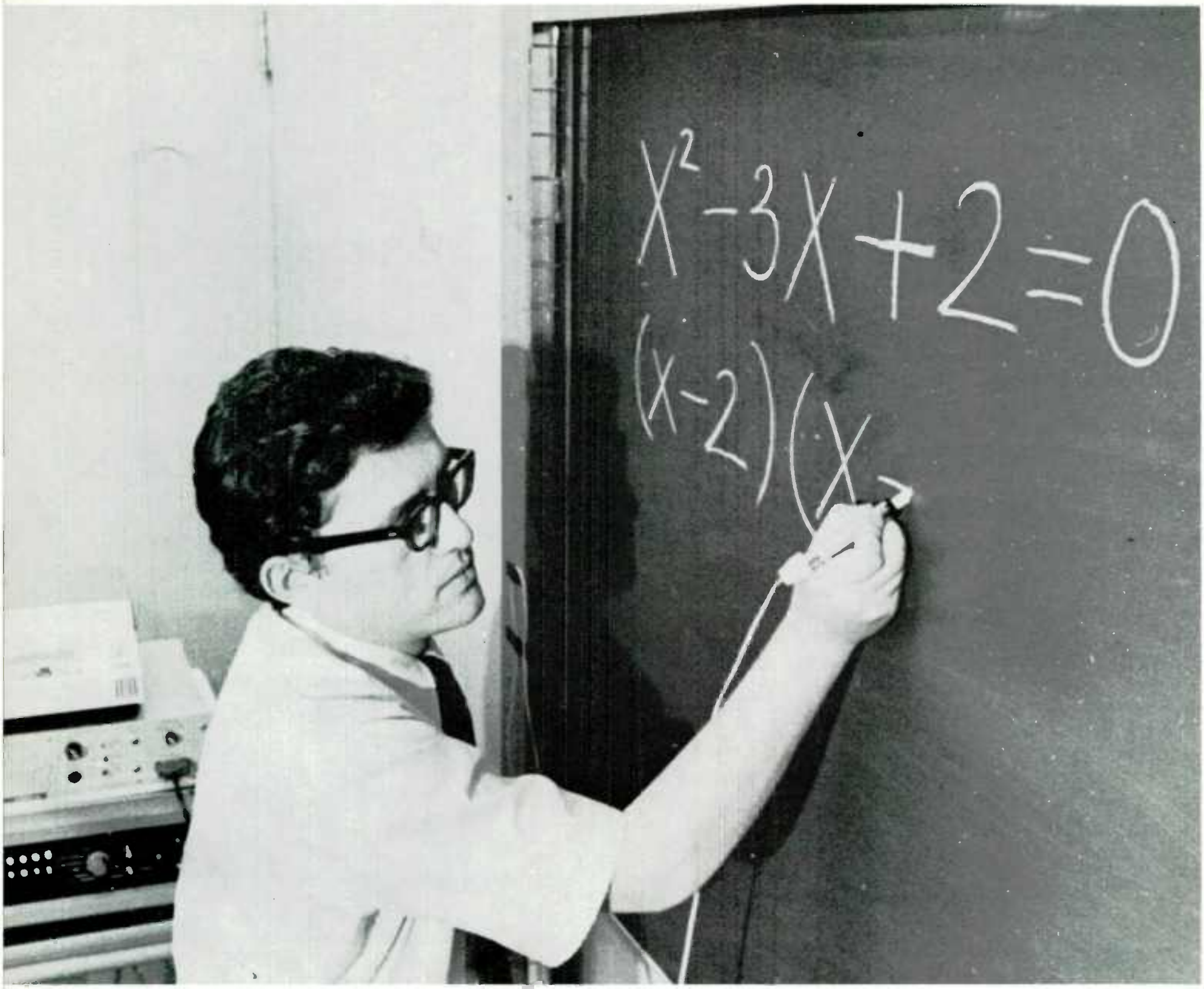


Photo Courtesy Bell Telephone Labs

"Remote Blackboard" System Uses Telephone Network

An experimental system for transmitting and receiving handwritten information over telephone lines now used to carry conversations.

An experimental system for transmitting and receiving handwritten information over the same telephone lines that now carry conversations has been devised by Bell Laboratories engineers in Holmdel, New Jersey.

Dubbed the "remote blackboard" by Blake McDowell, Len O'Boyle, and Bill Levin, the new system encodes handwriting motions on a writing surface into "bits" of information which are sent over ordinary telephone lines to a distant location. There, the information is electronically translated and recorded on a special self-developing photosensitive film for simultaneous projection onto a large viewing screen. The recorded film may be stored for future viewing.

Information is displayed by the receiving station in real time or nearly as it is written at the transmitter.

A major contribution to the technology of large screen, real-time displays, the "remote blackboard" system may one day be used along with a portable conference telephone, recently introduced by the Bell System, to transmit

World Radio History

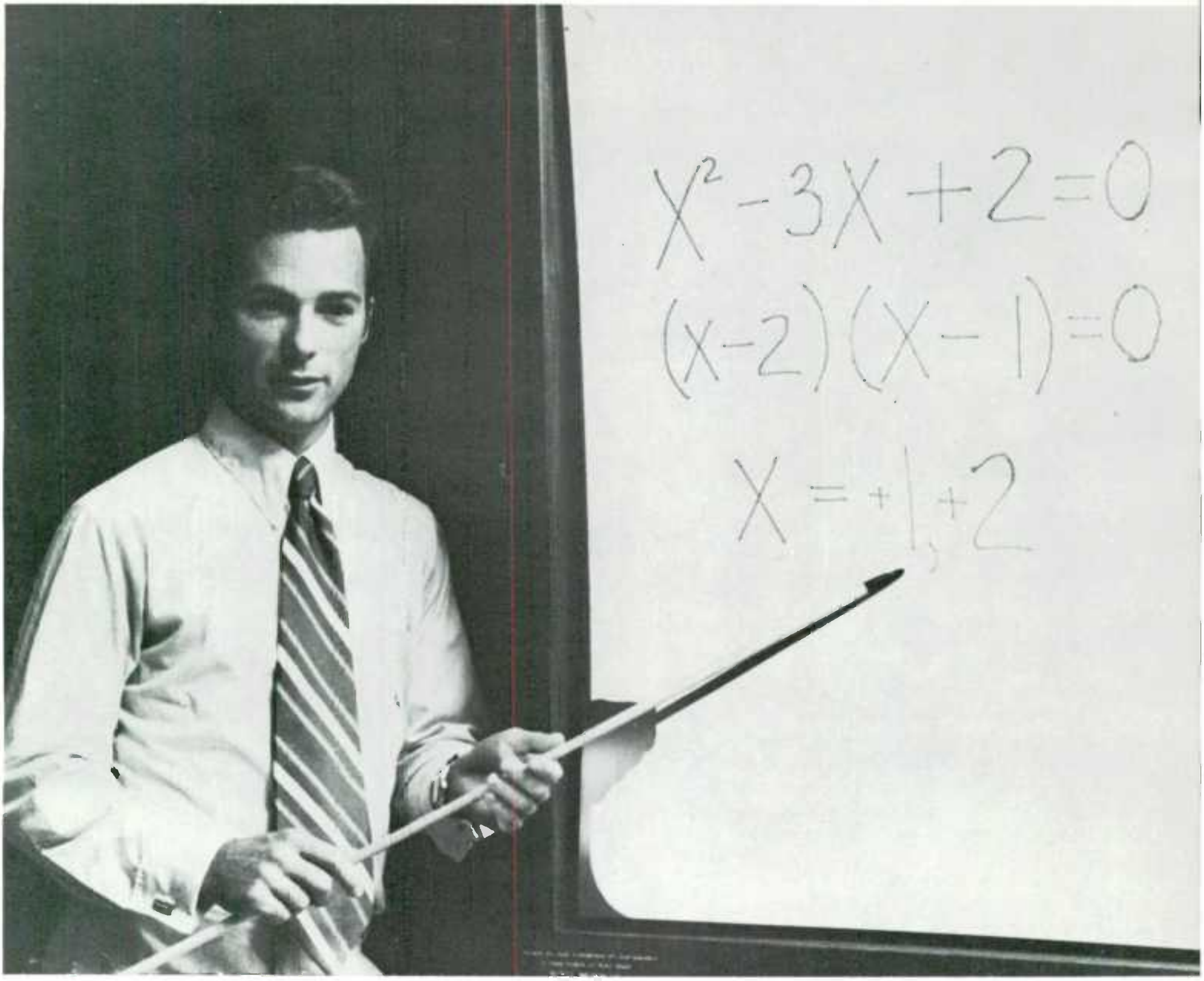


Photo Courtesy Bell Telephone Labs

In the photo on the preceding page, BTL engineer Len O'Boyle is electronically translating an algebraic equation into ultrasonic pulses which will then be transmitted over ordinary telephone lines via the experimental "remote blackboard" system. In the above photo, BTL engineer, Blake McDowell points to completed handwritten equation which was received from a distant location. Among its many possibilities, the "remote blackboard" may be adapted for use in teaching systems in the field of education.

both audio and graphic information to distant classrooms, lecture halls, conference rooms, and offices. The system could also be used to bring classroom instruction to bedridden or invalid students. Conceivably, an entire lecture with handwriting, sketches, and diagrams could be recorded on an ordinary stereo tape recorder at one location, and transmitted via the new system over telephone lines to a number of different classes meeting at various times and locations.

In order to transmit handwriting and graphic information in the "remote blackboard" system, a tiny "location indicator" attached to a writing instrument (which might be chalk, pen, Pencil, or stylus) is used to determine all movements performed on a writing surface. A user may write or draw in a normal manner and at his accustomed speed.

The location indicator is a commercial electronic device that provides a steady series of ultrasonic pulses. These pulses indicate the precise location of writing instrument as it is moved over a writing surface bounded by two "continuous strip" or bar-shaped microphones. The microphones are sensitive enough to accurately detect the location of the chalk or stylus at any point on the writing area. Lifting the location detector from the writing surface interrupts the "write signal".

Handwriting motions in the "remote blackboard" system generate a stream of electrical pulses. These pulses are fed to a data set that converts them to signals easily transmitted over telephone lines.

At the receiving terminal, another data set translates the incoming signals back to electrical pulses to drive two galvanometers (rotating mirrors). The galvanometers are used to detect an ultraviolet light beam to follow all the motions performed on the writing surface at the transmitting terminal. As the ultraviolet beam "moves" across a special photosensitive film handwriting is reproduced, and simultaneously projected onto a wall or a screen.

World Radio History

Braille Verifier for Blind Typists

A Braille verifier for blind typists is being developed at West Virginia University. The pilot model was built by Dr. I. M. Neou and his staff at the Visual Lab.

The Braille verifier, which is thought to be the world's first, will allow a blind typist to proofread his own work. Although it is still in the development stage, the idea holds great promise for blind secretaries and clerical work.

A Special Report from West Virginia University

A Braille verifier for blind typists is under development at West Virginia University and the first prototype has been completed.

The verifier, which can be attached to standard manual or electric typewriters, enables a blind secretary to check for errors by touch reading each line by means of Braille displays.

Dr. I. M. Neou of WVU's Department of Mechanical Engineering is in charge of the development, and the first prototype verifier was built by him and his staff at the Visual Prosthetics Laboratory.

Dr. Neou stresses that Braille verifiers are not yet commercially available and that this model is still in the developmental stage. He is now working on plans for a verifier that will allow a whole page to be checked at one time.

The Braille system, which was invented by Louis Braille in 1837, is a coded language used by the blind throughout the world. The alphabets, numbers and punctuation marks are represented by combinations of six raised dots. Besides these signs, there are 189 contractions and abbreviations. Thus, although an expert in Braille can read as fast as the average person, it's not an easy system to master.

The major components of the verifier are an electronic encoder; a belt with Braille characters; an embosser for setting the pins; and a mechanical eraser for resetting the pins so that they can be used again.

As the typist strikes a key, the linkage of the typewriter closes a switch. This sends a signal to the encoder informing it which letter of the alphabet (and whether it's a capital), or number, or

(Continued on next page)

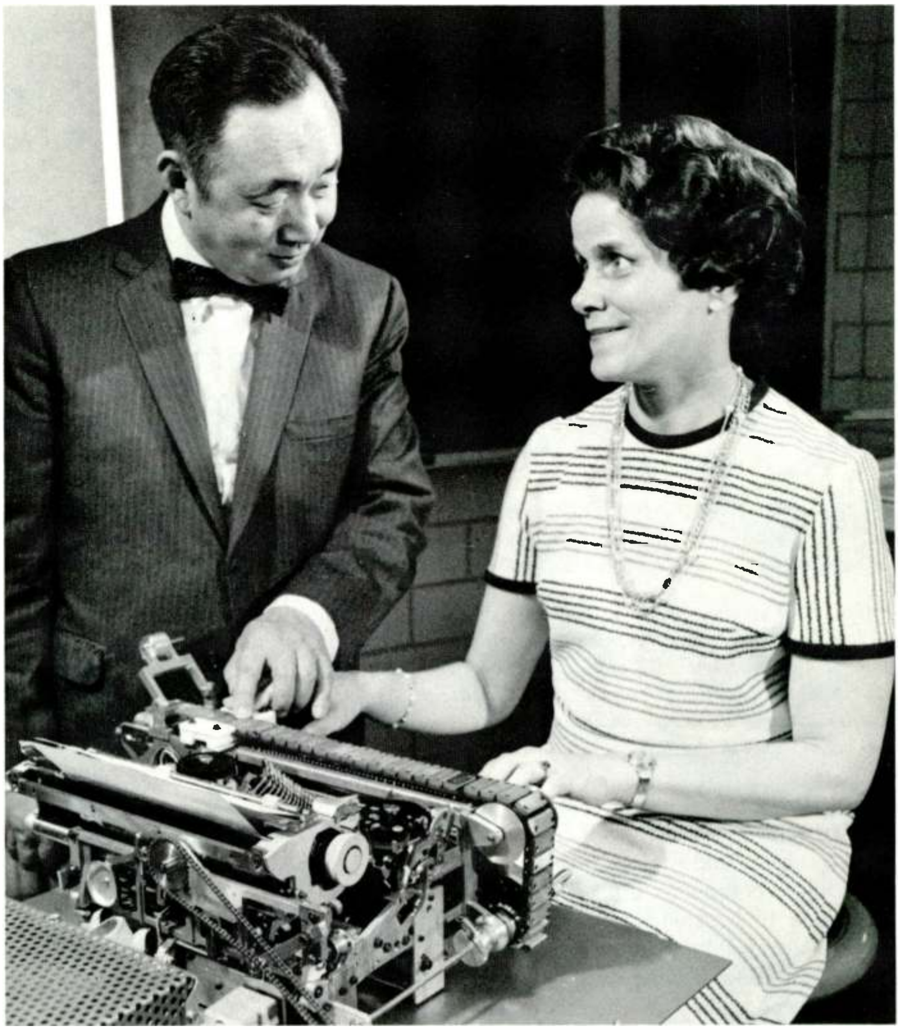


Photo Courtesy West Virginia University

Dr. I. M. Neou of West Virginia University's Department of Mechanical Engineering shows Miss Viola Smith, a blind secretary, how his new Braille verifier works. The verifier, which is thought to be the world's first, will allow a blind typist to proofread his own work. Although the verifier is still in the development stage, Miss Smith and other blind secretaries think that the idea has great promise. Dr. Neou has plans for an advanced model of the verifier that will allow a whole page to be checked at one time. His research is being supported by the U.S. Social and Rehabilitation Service of the Department of Health, Education, and Welfare, and the West Virginia Division of Vocational Rehabilitation.

World Radio History

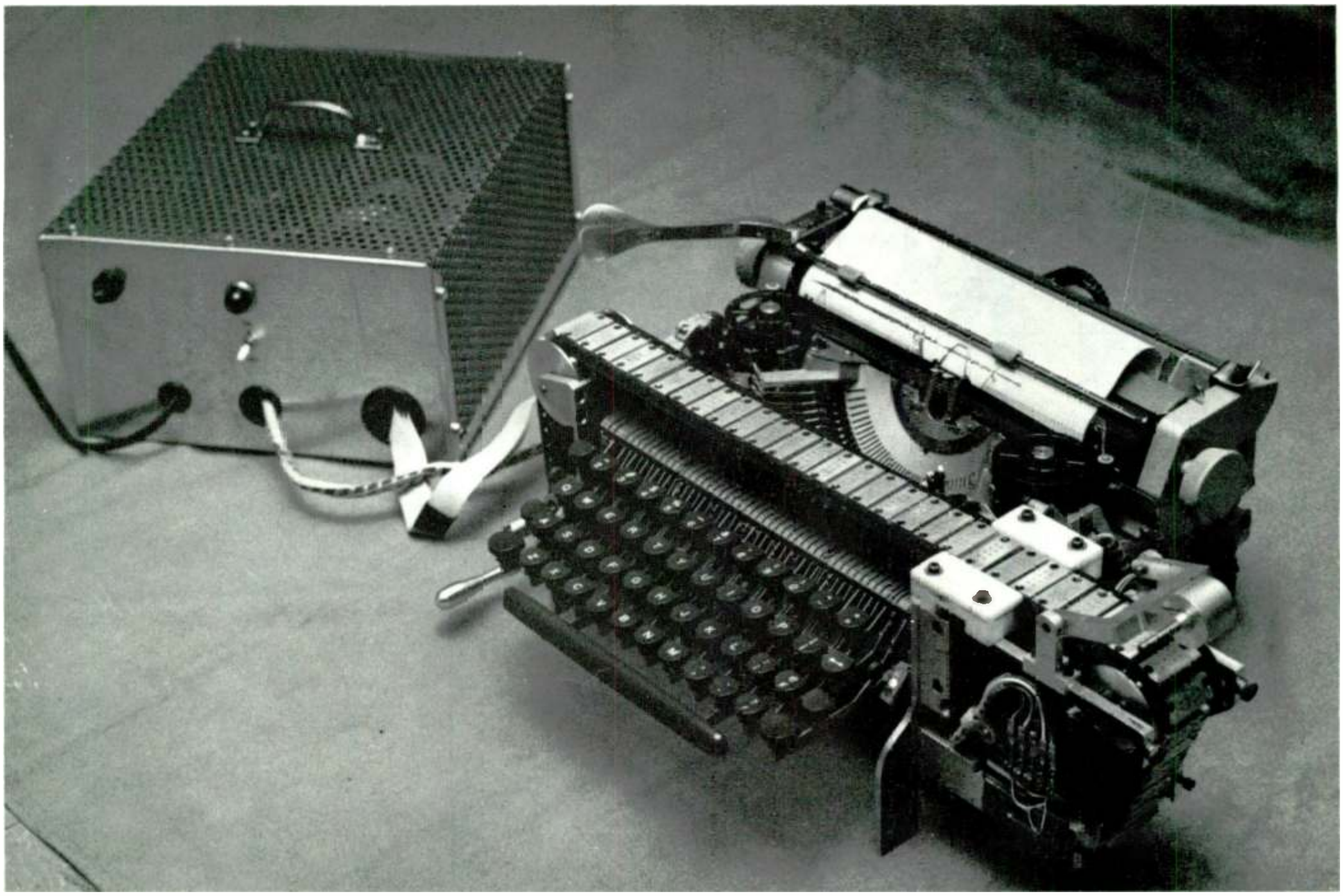


Photo Courtesy West Virginia University

The major components of the verifier are an electronic encoder (at the left in the picture); a belt with 80 Braille display cells, each of which contains a set of eight pins for forming the Braille characters; and electromechanical embosser for setting the pins; and an eraser for resetting the pins to the neutral position (the cylinder at the right of the picture). As a blind typist strikes a key on the conventional keyboard to type, the typelink automatically closes a particular circuit leading to the electronic encoder, or translator, which translates the keyboard alphanumeric input into Braille code, and the selectively energized solenoids raise the tiny Braille pins in the cell passing through the embossing station. Each Braille cell has eight pins; six for forming regular Braille characters and the left and right bottom pins for number and capital letter signs respectively. The aluminum Braille cells are mounted on an endless conveyer-type belt that is driven by a constant-force spring motor in synchronization with the motion of the carriage. On finishing a line, the blind typist can check her work by touch-reading the pin formations on the Braille cells. If a mistake is found, she returns the Braille cell with the error to the embossing station and thus brings the erroneous ink print to the typing area for correction. An eraser roller is provided to clear the cells for reuse by pushing the pins to the neutral position.

punctuation mark has been selected. The encoder, which translates from the alphabet to the Braille code, then sends a message to the embosser under the belt that actuates the pins to form the proper Braille character. The next link of the belt moves over the embosser just before the typist strikes the next key.

After finishing a line, the typist can check the work by touch-reading the belt and make corrections without help from a sighted person. If a mistake is found, she returns the Braille cell with the error to the embossing station and thus brings the erroneous ink print to the typing area for correction. The pins are then reset to the neutral position by turning the belt backwards with a crank and holding down on a revolving cylinder that serves as an eraser.

Dr. Neous recently demonstrated the Braille verifier at the National Rehabilitation Association's mid-Atlantic regional conference, held in Charleston, W. Va. At the conference Dr. Neou received a certificate of honor in recognition of his contributions to the handicapped. Many of those at the conference regarded the new verifier as a breakthrough for blind typists.

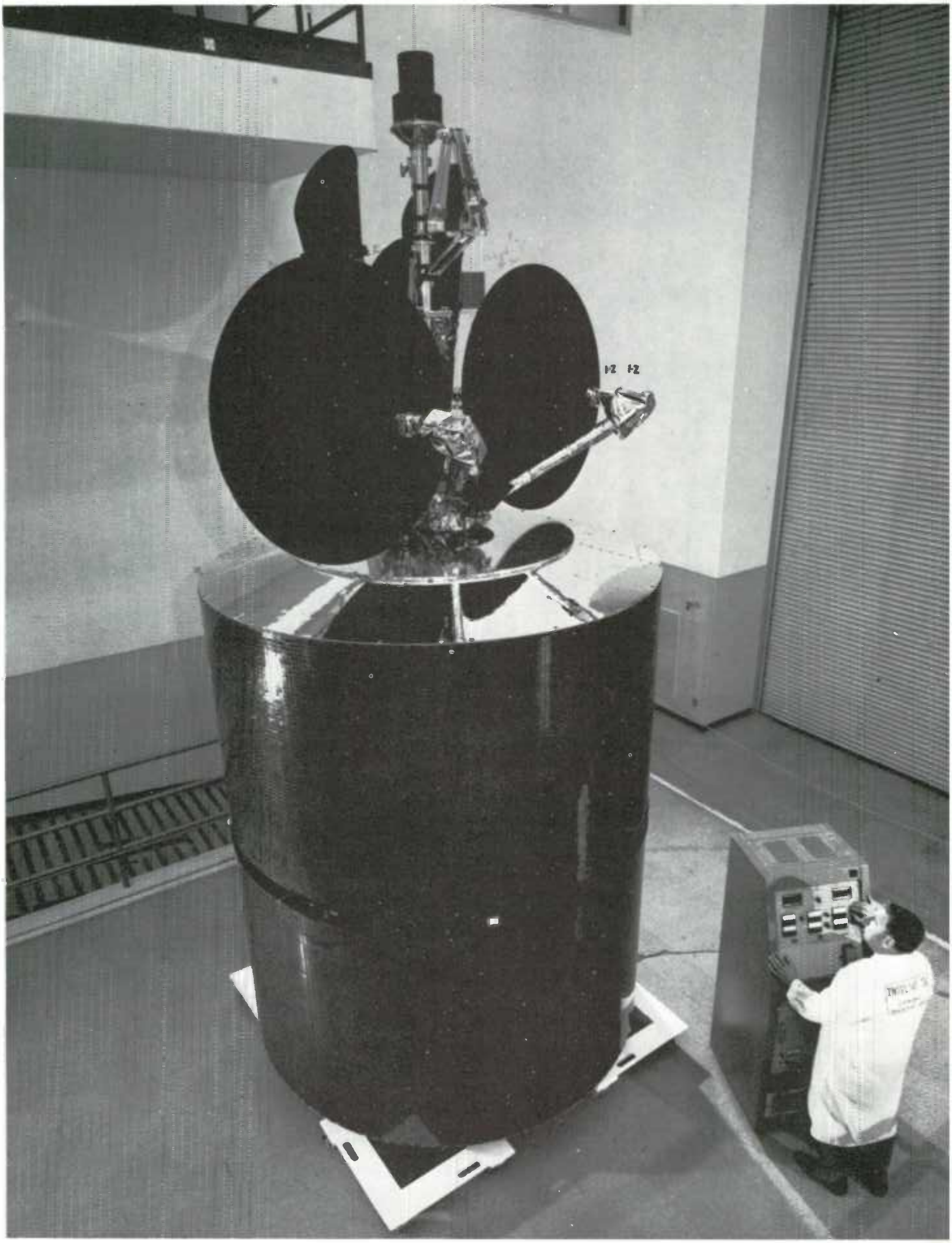
"It is a break, but not through yet," according to Dr. Neou. "We need more time and money to make improvements. We have a new design ready for a second generation verifier that promises to be simpler, more compact, and capable of storing a whole page of typing for playback in Braille.

"If the second generation verifiers were mass-produced, we think they could be sold for about $200 and thus be within the reach of the average blind person," Dr. Neou said.

The development of the Braille verifier was supported by the U. S. Social and Rehabilitation Service of the Department of Health, Education, and Welfare (HEW) and the West Virginia Division of Vocational Rehabilitation.

Roy S. Nutter, Jr. of Kingwood; Y. T. Lin of Taiwan, China; Albert Garcia of Moundsville; and Wayne Erwin, Jr. of Hurricane worked with Dr. Neou on this project.

World Radio History



Hughes Aircraft Company

World Radio History

The New Internationally-Built Intelsat IV

A new internationally-built Intelsat IV communications satellite, the first to be assembled in Europe, is launched at Cape Kennedy in the U. S. A.

Special Report

A new internationally-built Intelsat IV communications satellite, the first to be assembled in Europe, was successfully launched January 22 aboard an Atlas-Centaur rocket that will hurl it toward a synchronous orbit over the Pacific Ocean.

The giant space switchboard, built by Hughes Aircraft Company and an international team of subcontractors, will provide a new web of two-way telephone circuits and television channels to link many Pacific nations with the United States and Europe.

The new Intelsat IV, if successfully placed in orbit, will link earth stations in Australia, Hong Kong, Korea, Thailand, Taiwan, the Philippines and New Zealand with U.S. ground stations in Alaska, Washington, Guam, Hawaii and Jamesburg, Calif.

The satellite will be controlled and operated in space by the Communications Satellite Corporation (Comsat), manager for the 82-nation International Telecommunications Satellite Consortium. The satellite will be the third Intelsat IV to be launched in less than a year.

Previous Intelsat IV launches occurred on January 25 and December 19 of last year. These were earmarked for commercial operation over the Atlantic Ocean. The first Intelsat IV was placed in commercial operation last March. The Intelsat IV launched in December presently is undergoing communications tests and is expected to begin commercial operations by the end of January.

Each of the huge satellites, which tower nearly 18 feet high and are nearly 8 feet in diameter, provides for an average capacity of 5,000 to 6,000 two-way phone circuits, or can transmit 12 simultaneous color TV broadcasts.

INTELSAT IV COMMUNICATIONS SATELLITE is shown at left as it was being checked out prior to its successful launching on January 22. Originally scheduled for launch January 19, Intelsat IV can carry 6,000 two-day telephone calls, or 12 television channels to link many Pacific nations with the U. S. and Europe. It is expected to be operational in time for President Nixon's visit to China.

The newest satellite, which was assembled at the British Aircraft Corporation space facility in Bristol, England, is the first spacecraft in the Intelsat IV program to be completely assembled in Europe.

Dr. Albert D. Wheelon, vice president and group executive of Hughes space and communications group in El Segundo, Calif., said each of the international firms engaged in the program has played significant roles in the building of satellites.

While earlier Intelsat programs had some non-U.S. participation, none approaches the degree of the present program, he said. Subcontracts worth nearly 26 per cent of the total initial contract for $72 million for the first four spacecraft were placed with the non-U.S. companies participating in the program, Wheelon said. In a follow-on contract in 1970 for four additional spacecraft valued at $36 million, about 9 per cent of this amount was allotted to non-U.S. subcontractors.

Other companies in addition to BAC, which made major contributions to the program, included Nippon Electric Company of Japan, which provided the repeater system used in the first Intelsat IV launched, and Telefunken of Germany, which built the repeater for the Intelsat IV launched last December. The repeater system in the new satellite was provided by Northern Electric Company of Canada.

Additional companies participating in the program included Thomson-CSF, of France; Kolster-Iberica in Spain; ETCA in Belgium; Svenska Radio of Sweden; Contraves in Switzerland; and Selenia in Italy.

The Intelsat IV satellites are equipped with 12 separate transponders, or amplifiers. Four of these are permanently connected to the global antenna system, which can illuminate about one-third of the earth's surface visible to the satellite from synchronous altitude.

The remaining eight amplifiers may also be connected to the global antenna system by ground control command, or may be linked to the satellite's two unique spot-beam antennas. These advanced technology antennas double the capacity of an individual amplifier and can pump a concentrated signal into a small area of the earth's visible surface for increased circuit capacity.

Flexibility of the satellite's communications system enables it to provide 3,000 to 9,000 telephone circuits, depending upon the number of spot-beams in use and the number of stations sharing the amplifier. However, general use of the satellite for current traffic requirements provides 5,000 to 6,000 two-way circuits plus TV capability.

The steerable dish antennas can direct their spot-beams to specifically selected areas of the world. The Intelsat IV above the Atlantic, for example, can aim one spot-beam antenna at the eastern U.S. and the other can be focused on western Europe to provide those areas with maximum circuit capacity.

In 1970, Comsat reported, 96 per cent of the circuits provided by the 1200-circuit Intelsat III series of satellites were in use. Major users included the American Telephone and Telegraph Company, biggest user of the satellites, and the National Aeronautics and Space Administration, which used them extensively for transmitting data from Apollo tracking stations.

Last December Comsat, which uses 42 per cent of the entire satellite system, reported 60 per cent of its traffic was over the Atlantic, 30 per cent over the Pacific and 10 per cent over the Indian Ocean.

Late last month the Intelsat IV above the Atlantic made the first transmission of a Picturephone message (where the parties see one another on a picture screen during the call) between Washington, D. C. and a new satellite tracking station in Sweden, one of the members of the Intelsat consortium.

The new generation of satellites, as well as their predecessors, generally replace high-frequency radio transmission of telephone calls between distant continents, which often were of poor quality, particularly during periods of sunspot interference with radio signals.

World Radio History

Plastic Missile Gets OK in Test Fire

A missile with an all-plastic airframe has been test-fired successfully on the first try by the U. S. Army Missile Command at Huntsville, Alabama

Special Report

A missile with an all-plastic airframe recently was test-fired successfully on the first try, it was announced recently by Hughes Aircraft Company, the missile's developer.

The firing, believed to be the world's first plastic missile launch, was conducted by the Army Missile Command at Huntsville, Ala.

In the test, the plastic missile withstood the aerodynamic forces encountered by conventional metal missiles during similar launches, said Charles G. Walance, manager of the Hughes components and materials laboratory, which performed the development program for the Army.

The new plastic missile technology, although still experimental, could have several advantages over metal missile fabrication, Walance said. He cited better aerodynamic heating performance, less corrosion problems, reduced radar reflectivity, less accidental dents and scars on airframes caused by typical field handling, and better cost-effectiveness. He also pointed out that plastic is a material more readily available than strategic metals.

To produce the missiles, a polyester resin-glass mat sheet compound is molded into four identical guadrants. The four segments, each containing a missile fin, are bonded together by epoxy paste to form a complete missile airframe. No mechanical fasteners nor threaded joints are used.

The manufacturing process could be used to make a wide variety of missiles in various shapes and sizes, including training missiles, target missiles, flight research vehicles and tactical weapons, Walance said. It would require less time and labor than most other missile manufacturing methods, he added.

Hughes Aircraft Company

This photograph shows the new missile which is made by molding a polyester resin-glass compound into four identical quadrants. The segments are then bonded together by epoxy paste to form a complete missile airframe. The plastic missile offers a number of advantages over metal types, including better aerodynamic heating performance, less corrosion, and reduced radar reflectivity. In addition, plastic is a material which is less costly and more readily available than strategic metals. The new missile, developed by Hughes Aircraft Company, is expected to revolutionize missile technology, as well as flight research vehicle technology.

World Radio History

Australian News and Information Service Photo

Underwater Sound Waves, Barrier to Killer-Sharks

Australia is fast closing in on man's most terrifying enemy of the sea, the killer-shark. After 11 years of research, it now seems certain that the ultimate protection against shark attack will come in the form of a sonic repellant

By Glyn May

Australia is fast closing in on man's most terrifying enemy of the sea, the killer-shark.

After 11 years of research, it now seems certain that the ultimate protection against shark attack will come in the form of a sonic repellant - the transmission of underwater sound waves that act as an invisible barrier.

Australia's leader in this field, Mr. Theo W. Brown of Sydney, believes that the final breakthrough could be "just around the corner."

He is already using individual signals to repel the whaler, tiger and hammerhead sharks, and the last - and most difficult - step is to produce an "all-purpose" sound pattern which will deter all species of known man-eaters.

Mr. Brown, a noted diver and underwater expert will step up his sonic repellant work in 1972 with further tests in the shark-infested waters of the outer Great Barrier Reef and around French Polynesia.

His research is backed by the French Government's Medical Oceanographic Branch (Institute of Medical Research of French Polynesia) in Papeete, Tahiti.

He also has been commissioned by the World Life Research Institute in Colton, California, to carry out a detailed survey on the reported Crown of Thorns starfish infestation in north-eastern Australian waters, and is presently based on Magnetic Island near Townsville in north Queensland.

Both projects are of world importance, but 36-year-old Theo Brown is the first to admit that he has more than a scientific interest in taming the shark.

He remembers vividly the horror of a sweltering, mid-summer day in January 1960.

He was swimming in Middle Harbour, Sydney, with 13-year-old schoolboy Kenneth William Murray.

(Continued on next page)

This article is published through the courtesy of The Australian News and Information Bureau, Canberra, Australia

World Radio History

SONIC REPELLANT
BARS KILLER-SHARKS
(Continued from page 11)

The boy was splashing and playing when, without warning, a greyish-white streak flashed through the water and ripped into his body with razor-sharp jaws.

Theo Brown, only yards away, dragged his shockingly-mauled friend ashore through the crimson water.

Within minutes, Kenneth William Murray was dead - and the terror of shark attack became indelibly burned into Theo Brown's memory.

"Until that moment," he recalls, "my only interest in sharks was that of any diver - to treat them with respect."

As he began delving into reasons for the boy's death, Theo Brown found that despite man's incredible advances in science, he still had not conquered one of the most primitive forms of life on earth.

"In fact," he says bluntly, "the history of shark repellants has been one of continued failure.

"Even though chemical shark repellants of a kind were developed in the early part of World War II - and later improved upon - none were entirely satisfactory."

He also found that mechanical devices such as "bubble fences" and electrical barriers also had proved virtually worthless.

And, more significantly, he discovered that the generally accepted method of "frightening away" sharks was to beat and splash the water furiously - which was precisely what Kenneth Murray was doing when he was fatally mauled.

After careful investigation, it became apparent that the shark had been attracted by the "sound stimulus" or sound vibrations emitted by the victim.

(One of the world's leading authorities on shark behaviour, Dr. Perry W. Gilbert of Mote Marine Laboratory in Florida, United States of America, has established that a shark responds to vibrations or distress signals at a distance of between 100 and 200 metres.)

To test this theory further, a series of experiments were carried out in northern Queensland and New Guinea waters.

These gave conclusive proof that through unusual, erratic or violent motions in the water, a swimmer transmits a form of sound vibration or frequency combination attractive to a shark.

This distress stimulus was found to be similar to the vibrations of a wounded fish.

Swimming strokes also were studied, and it was established that a relaxed form of breaststroke was the safest method of moving through shark-infested waters.

It was then reasoned that if sound played an important part in attracting sharks, perhaps the reverse would apply - and that a repellant effect could be achieved underwater with selected sound frequencies.

"In the early stages we tried everything," Theo recalls with a grin, ". . . recordings of sirens, bells, gongs, whistles, musical instruments, human voices, screams, cheering, sounds of auto crashes, jet and piston engines, gunshots, explosions.

"But the results were so varied and unpredictable that any uniform comparison was out of the question."

For instance, he says, The Beatles recording of "Oh Yeah!" played through loudspeakers underwater, at first sent sharks scurrying for cover.

But later, like many land creatures, they soon became accustomed to the pounding Mersey beat and gathered around the source of the noise like an adoring aquatic fan club.

On another occasion, two salvage divers working some distance from Theo Brown's ocean floor "laboratory," thought they were suffering from rapture of the deep when they heard the distinct sound of an express train roaring over a bridge.

Eventually he found one radio-type signal that would attract all sharks, and in fact, sharks now can be moved en masse from one area to another.

(He has often carried out "Pied Piper" demonstrations by trailing a submerged bleeping loud speaker behind a boat and leading packs of sharks around).

The "call in" signal, when transmitted continuously, drives sharks into a state of frenzy.

In one experiment, the trasmitting unit was hidden inside a narrow coral cave and switched on.

Sharks moved into the area, slowly at first, and then gradually becoming more agitated as they tried to find the source of the signal.

Finally they reached the stage of suicide frenzy - attacking the sound with such ferocity that they became jammed in the opening and battered themselves to death.

"When one sees such frenzy it is not difficult to understand why the survivors of a disaster at sea stand little chance in the water," Theo Brown says.

"The impact of a ditching aircraft, or the sounds of a sinking ship bring all the sharks in the area hurrying to the scene.

"When nothing else remains in the water to consume, they often turn on each other.

"During experimental work at Rangiroa Atoll, I have seen more than 200 sharks completely devour one of their number at such incredible speed that nothing remained - not even enough blood to discolour the water."

Following the discovery of a successful call-in signal, the next logical step was to search for a frequency that would repel - and in this there is still one missing link.

"While one frequency attracts all sharks, at present it requires separate sounds for each species to bring about a repellant effect," he says.

"The key will be in locating one all-purpose 'mixed' sound between infra-sonic and ultra-sonic (from 50 to 15,000 cycles.)"

A final solution, he says, would have enormous commercial, military and private application.

Most important among these, would be the ability to fit small, automatic sonic-repellant devices into the fuselage of commercial aircraft.

"Think of the consequences if a 747 jet ditched in the Pacific," he says.

"Even if they survived the crash - and this is entirely possible - the occupants wouldn't stand a chance against sharks."

"No one knows how many seaman and fliers were devoured by sharks during World War II.

"Not even the toll taken in Australia's coastal waters can be accurately assessed as many of those supposed to have drowned but whose bodies were never found may have been shark attack victims."

He quotes an authenticated account of the torpedoing of a British cruiser in the South Atlantic on December 7, 1941:

> "As the burning cruiser settled in the water, injured and bleeding men jumped over the side and splashed towards life rafts. Blood from open wounds began to difuse around the swimmers. Panicky, jerky, splashing movements from wounded men echoed outwards through the water. The first sharks to arrive immediately attacked the struggling swimmers. Razor teeth sheared into screaming men and sliced away large mouthfuls of flesh. Limbs were chopped off in single bites; severed arteries pumped yet more blood into the water. The

(Continued on page 14)

World Radio History

IN REMEMBRANCE...

By William M. Palmer

Let us honor our men of science
Who once walked upon the planet Earth
Along the uncharted trails of electronics
In search of a better way of life
For all mankind

FOR THE MONTHS OF JANUARY/FEBRUARY 1972

EDWIN HOWARD ARMSTRONG

December 18, 1890 - February 1, 1954

FM (frequency modulation) radio ranks as one of the greatest discoveries of all time, and yet, the name of its inventor, Edwin Armstrong, once a professor of engineering at Columbia University, remains obscure in a society which has benefitted immeasurably from his inventive genius – a society overshadowed by growing demands for a utopia and ungratefulness for the good things of life it has inherited.

From Armstrong's inventive mind came also the regenerative feed-back and superhetrodyne principles, the latter of which is widely used in our modern radio receivers. Millions of Americans view television programs every day without realizing that all sound emanating from their set is that same static-free FM reception.

In 1954, the U. S. Army Signal Corps recognized his valuable contributions to military communications by dedicating to his memory a museum of early-day radio equipment at Fort Monmouth, New Jersey, designating it "Armstrong Hall." Much of his early experimental equipment is in the Smithsonian Institution in Washington, D. C.

ELISHA GRAY

August 2, 1835 - January 21, 1901

Elisha Gray, like many other great men came from families of humble background. And for him, adversity began early in life. The sudden death of his father forced young Elisha to drop out of elementary school and take a job to help support his family.

During the next few years, he took whatever work he could find; and just a bare existence seemed like an insurmountable struggle. He did discover, during this time, a dormant aptitude for carpentry work. By age 22 Gray was earning enough money to pay his way through three years of preparatory school, and later two years of college. His main interest in college centered in physical sciences and electrical mechanisms.

In the years that followed, Gray was granted patents on more than 100 electrical devices, one of the most important of which was the telautograph, patented in 1888. This device transmitted facsimile writing and drawing over considerable distances, and at great speed.

Gray was a co-founder of Western Electric Manufacturing Company, which later became the Western Electric Company we know today as the manufacturing facility for Bell Telephone. He was also a co-founder of Graybar Electric Company, now owned by its employees.

This is only one of many poignant stories portraying the unyielding will to achieve that has characterized our men of science. Here we see again the basic formula at work in the building of America.

KARL GUTHE JANSKY

October 22, 1905 - February 14, 1950

The science of radio astronomy began only a few decades ago through the research of a young physicist at the Bell Telephone Laboratories field station at Holmdel, New Jersey. The name of the young man was Karl Guthe Jansky. His discovery enabled mankind to gain new knowledge of the universe far beyond the dreams of the astronomers of that day. It parted the vail that has hidden outer space since time began.

Jansky announced his discovery of radio waves from outer space at a meeting of the International Scientific Radio Union on April 27, 1933. Thus, was born the science of radio astronomy.

The son of a professor of electrical engineering at the University of Oklahoma, Karl Jansky was born in Norman, Oklahoma, on October 22, 1905.

DAVID SARNOFF

February 27, 1891 - December 12, 1971

David Sarnoff, 80, one of America's most brilliant leaders in the field of electronics, died at his home in New York city on December 12, 1971. He had been in failing health for several years.

Sarnoff, the son of an immigrant, was born February 27, 1891 in the little village of Uzilan, not far from the city of Minsk, Russia.

Not long after his arrival in America in 1900, Sarnoff was forced by the untimely death of his father to become the family's breadwinner. He sold newspapers, worked as a delivery boy . . . whatever job he could find in order to keep the family together.

At age 15, the first link in a long and eventful chain of events began – a chain of events which would one day carry him to the heights of achievement as head of the world famous Radio Corporation of America. This first link, a job as a messenger boy for the Commercial Cable Company, enabled him to save from his meager pay enough money to purchase a telegraph instrument. Sarnoff, using every spare moment for tedious practice, taught himself the Morse Code.

A short time later he took a job as a $5.50 a week office boy with the Marconi Wireless Telegraph Company, at 27 William Street in New York City, in order, "to get a foot in the door." Within two years, Sarnoff was promoted to full-time operator at a Marconi wireless station on Nantucket Island off the coast of Massachusetts.

Sarnoff, with an insatiable will to achieve, continued step-by-step up the proverbial ladder of success to reach the pinnacle of leadership in his chosen field of electronics.

His life was the epitome of the tradition that built America into a nation having the highest standard of living ever achieved by mankind. It was the same formula that brought unprecedented economic growth to America.

What a contrast to contemporary thinking that success can be given . . . that success is not possible, under adverse circumstances, without a government subsidy.

NIKOLA TESLA

July 10, 1856 - January 7, 1943

This year marks the twenty-ninth anniversary of the death of Nikola Tesla, who has often been hailed as the world's most prolific inventor. The great inventor, who never married, chose to devote his life to scientific research. So,

(Continued on next page)

World Radio History

IN REMEMBRANCE . . .
(Continued from preceding page)

when the end came, he died alone, as he had lived, in the eighty-seventh year of his life.

Tesla came to America in the 1880s as an immigrant, with only pennies in his pocket and a long cherished dream in his heart. This dream finally came true when the enormous water-power of Niagara Falls, in New York, was harnessed to produce the first hydro-electric, A. C. (alternating current), power for commercial customers. Tesla's polyphase system demonstrated beyond any doubt its superiority over the Edison D. C. (direct current) power system. It was also more efficient, mechanically.

Tesla's momentous discovery should have brought him immense wealth, yet, the opposite was true. The inventor virtually gave away his invention to a manufacturing facility in return for a promise that no expense would be spared in developing it for the ultimate benefit of all mankind.

So, when you drive across the mountains, the plains, and the pleasant valleys of America today, behold the monuments to his genius . . . the tall towers and high voltage lines that feed abundant electric power to our cities, and to the farm homes that dot the rural scene.

The perceptive and imaginative mind of Tesla brought forth a host of other noteworthy inventions. They included such devices as an arc-light system, an electronic tube, a remote control device, and other important devices which advanced technology in the fields of communications and use of x-rays in the field of medicine.

Young people and old alike should occasionally pause for a moment to recount the conveniences and happiness enjoyed in our country as a legacy of our men of science – men like Nikola Tesla, the Serbian inventor, who came to America to help build a great nation . . . who left behind him a better way of life for all mankind.

SONIC REPELLANT
BARS KILLER-SHARKS
(Continued from page 12)

ocean foamed red as more sharks arrived and feasted on the helpless survivors.

"There is little a man can do to defend himself once a shark attack is launched. The lucky ones clawed their way aboard the rafts and beat at the snapping sharks with paddles and flotsam.

"When the shocking feast was over, 280 men had died. Only 170 of the cruiser's complement of 450 men survived the torpedoing and frenzy feeding of the sharks."

Theo Brown says that the proposed aircraft sonic repellant devices have already been designed in England and could be fitted immediately the correct frequency was determined.

It was proposed to install three small transmitters under the belly of the fuselage in each large jet.

These would be activated by water pressure on impact and emit a continuous repellant signal.

Similar transmitters could be strung across surfing and swimming areas anywhere in the world, and carried by seamen, fishermen, and pleasure craft.

Sydney Harbour, he says, could be cleared of sharks by leading them out to sea with "attraction" transmissions and stringing a series of small transmitters deep across the harbour mouth.

An appropriate ultra-sonic frequency could be incorporated in the signal so as to inhibit the growth of marine organisms on the transmitting unit.

A pocket set (about the size of two cigarette packets) could be easily developed for attachment to lifejackets.

One of the major technical problems in the sonic shark repellant programme was to perfect an underwater loudspeaker that would transmit pure signal tones up to 100 ft.

However this was solved by Pioneer Electronic Corporation of Tokyo, and sets are already on the market.

words to live by. . .

"When one starts poor, as most men do in the race of life, free society is such that he knows he can better his condition; he knows that there is no fixed condition of labor for his whole life. I am not ashamed to confess that twenty-five years ago I was a hired laborer, mauling rails at work on a flat-boat – just what might happen to any poor man's son. I want every man to have a chance in which he can better his condition – when he may look forward and hope to be a hired laborer this year and the next, work for himself afterward, and finally to hire men to work for him. That is the true system."

Abraham Lincoln

World Radio History

history's hall of honor T.M.

BIOGRAPHICAL SKETCHES OF GREAT MEN IN ELECTRONICS

Karl E. Hassel

Pioneer Radio Amateur/Manufacturer

Born January 25, 1896

by William M. Palmer

Ever since the famed Italian inventor Guglielmo Marconi sparked the letter "S" in Morse code across the Atlantic Ocean, the mysteriously impressive feat of sending and receiving messages through the air – wireless, or radio as we call it today – has captured the imagination and hearts of young men and old alike.

Although there have been many claims to the invention of wireless telegraphy, Marconi was the first to assemble out of the available knowledge of that era receiving and transmission apparatus which convincingly demonstrated to mankind the feasibility of wireless as a medium of communication. He turned knowledge into action, and action into progress. He led mankind across a new frontier.

Now, seven decades later, amateur radio operators, or "hams" as they are often dubbed, are still dot-dashing and chatting over the radio waves. But it's not all play! The heroic feats of Hams in providing emergency communications during hurricanes, floods, earthquakes, and other civil disasters are legend. Today, in the United States, there are nearly 300,000 amateur radio operators . . . forming the most useful non-governmental, non-commercial communications network in the world.

In addition to this, radio amateurs have made countless technological contributions to radio. Their unselfish devotion to public service on their own time and expense has written a unique chapter in the history of mankind. They have been ambassadors of goodwill of the highest order in their contacts with radio amateurs in other nations of the world.

The year 1915 marked an important crossroad in the life of one of our early-day amateur radio operators from the little town of Sharpsville, Pennsylvania. You may never have heard of him in the strictest sence of the word, nevertheless, you undoubtedly have heard of, and perhaps bought, radio receivers, television sets, record players, and other electronic gear bearing the trade name which grew out of a hobby. The name of the man is Karl E. Hassel; and the trade name is Zenith.

Mr. Hassel, who was born in Sharon, Pennsylvania, on January 25, 1896, is the son of Charles and Alice Lunn Hassel.

He attended Westminister College from 1914-1915, and graduated that same year from the University of Pittsburg, where he held the distinction of being the only person on campus – student or faculty – who knew how to operate the University's newly constructed radio station.

During World War I, Mr. Hassel served in the U.S. Navy as electrician, 2nd class, radio. It was while serving at the Great Lakes Naval Training Station that he met R. H. G. Mathews of Chicago, another amateur radio operator, who had built and sold radio equipment to other amateurs. Their mutual interest in radio led to a friendship and eventual business partnership in manufacturing radio equipment after the war.

Operating under the name Chicago Radio Laboratory, the young pathfinders in electronics set up their first assembly line on a table in the Mathews' kitchen. Their tools consisted of pliers, screwdrivers, a hand drill, saw, and soldering iron which had to be heated over the burner of a gas stove. It was from this humble kitchen assembly line that a great radio business, Zenith Radio Corporation, came into being several years later.

The youthful radio manufacturers began the long chain of radio "firsts" which have characterized the growth of

(Continued on page 19)

World Radio History

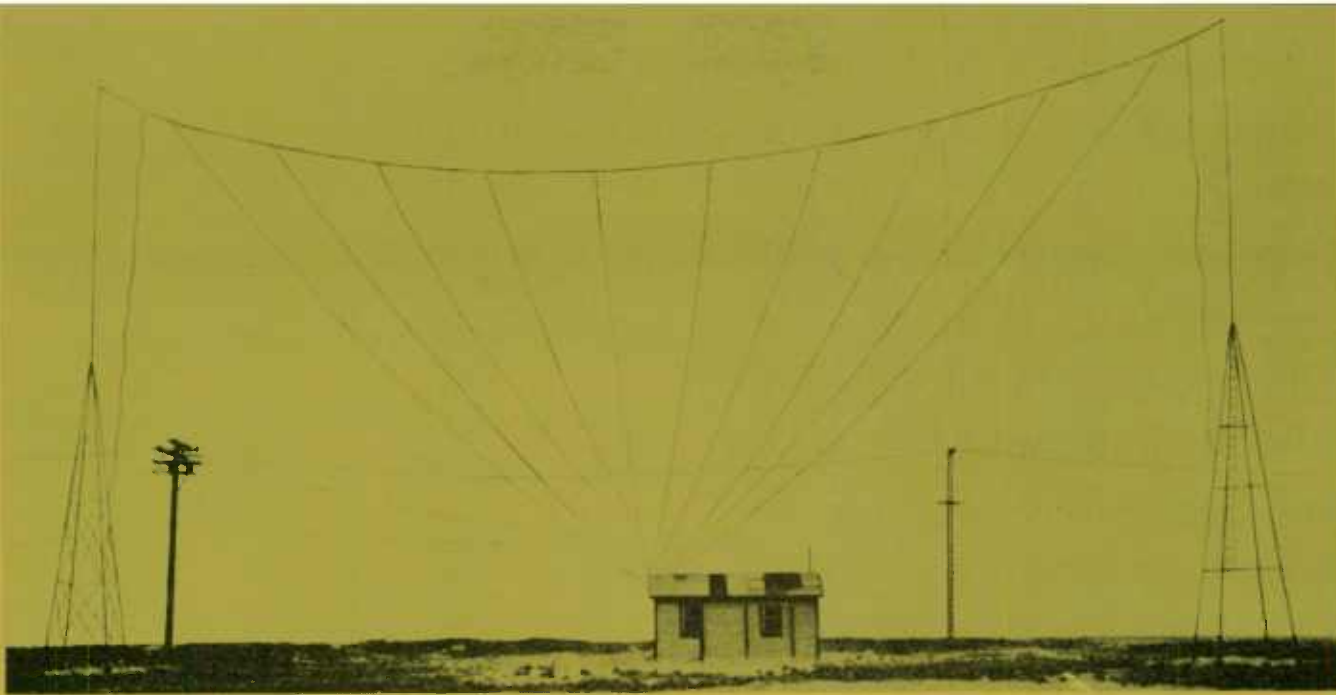
Zenith Radio Corporation

Karl E. Hassel

Pioneer Radio Amateur/ Manufacturer

Born January 25, 1896

World Radio History



Courtesy of Zenith Radio Corporation

In 1919, this little "factory" which also housed amateur radio station 9ZN was built by Karl Hassel and R. H. G. Mathews on Chicago's North Side. It was here that "Z-Nith" radio products were first manufactured – the forerunner of the world famous Zenith Radio Corporation.

KARL E. HASSEL
(Continued from page 17)

Zenith. One of their electronic projects was the construction of a long wave radio receiver for the Chicago *Tribune*. This famous radio receiver picked up news stories about the postwar (World War I) Versailles Peace Conference directly from a long wave radio station in France and thus enabled the *Tribune* to scoop competitors, who had to wait for news dispatches via the congested transatlantic 12 to 24 hours later. It was an astonishing feat in that day!

The modest manufacturing operations of Chicago Radio Laboratory continued to grow at a rapid pace in keeping with increased consumer interest in the sensation of the century, radio. It had soon outgrown the kitchen table. So with faith in the future of radio, the young businessmen figured a way to use some of their capital to build a new "factory." Although it resembled, somewhat, a shanty type building, it did provide them with the large work and assembly space of fourteen by eighteen feet . . . plus a corner for their amateur radio station, 9ZN. The new structure was located near the famous Edgewater Beach Hotel in Chicago. At the same time, they took another forward-looking step, the publishing of their first catalog of radio equipment. Then, several months later they got together in a "brainstorming" session and came up with a trade name for their radio equipment which was destined to become world famous. They called it "Z-Nith" – formed out of the call letters of their amateur radio station, 9ZN. This was the embryonic forerunner of the famous trademark we all know today: Zenith – an interesting historical sidelight unknown by many people.

The next first for *Z-Nith* was the construction and installation of radio equipment for the N.C. & St. L. which became the world's first railroad to successfully dispatch trains by "wireless" telegraph. The transmitting and receiving equipment was installed at two locations: Tullahoma, Tennessee, and Guntersville, Alabama.

Young Hassel and Mathews further demonstrated their keen vision when they hurriedly developed a practical receiver with which the general public could hear the growing number of news, weather, and general programs from various broadcasting stations. Within a few months Chicago Radio Laboratory was out of space as business continued to skyrocket. So the company moved to a new location on Ravenswood Avenue where their rental jumped to $300 per month, and their payroll increased to six employees. With the addition of a motor-driven drill press, the plants production increased to the amazing rate of one radio set per day.

By 1922, CRL's business had increased to the point of demanding additional capital for expansion together with a more effective marketing program. This need was provided for through a fortuitous meeting and later agreement with Commander E. F. McDonald, Jr., of Syracuse, New York, who had both financial backing and business acumen. This combination led to the organizing of Zenith Radio Corporation in 1923. The new corporation initially functioned as the exclusive sales and marketing organization for equipment manufactured by Chicago Radio Laboratory. Then, shortly thereafter, the entire assets of CRL were acquired by Zenith Radio Corporation which then became a manufacturer in its own name.

Mr. Hassel was elected to the Zenith board of directors on June 28, 1932, assistant vice-president on March 13, 1943, and secretary of the corporation on November 11, 1949. He retired from full-time duties at Zenith on January 1, 1966.

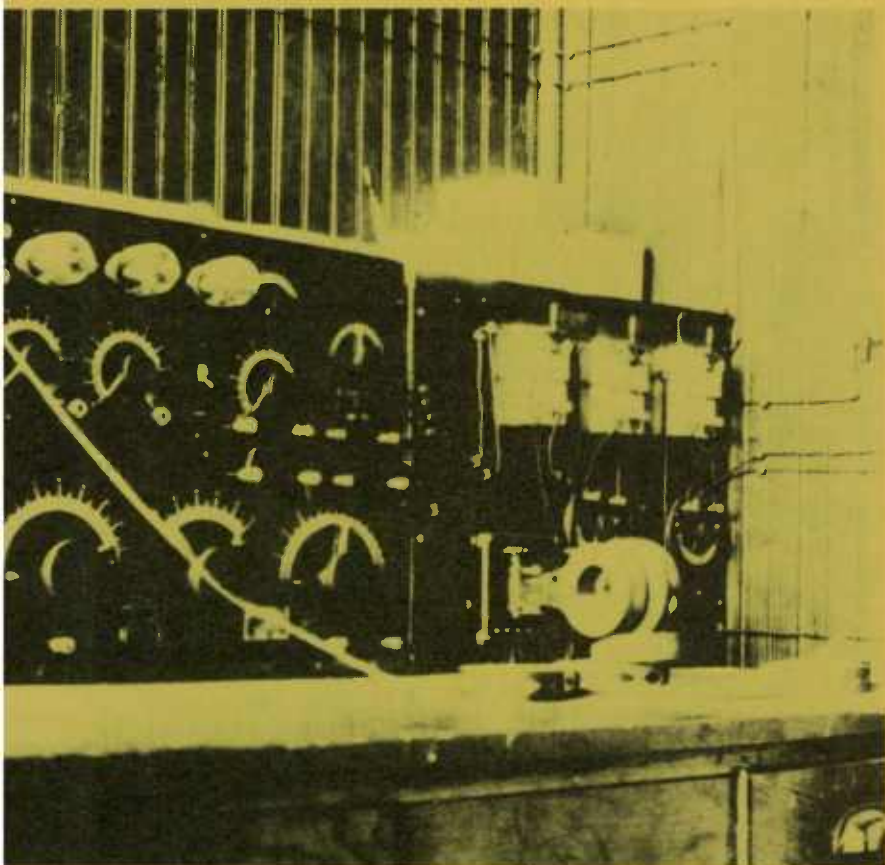
He has been a member of the Institute of Radio Engineers (now IEEE) since 1919; and a senior member since 1943.

All Americans should be proud of the distinguished achievements of Karl E. Hassel and his important contribution to the development of electronics which has played a major role in the progress of our country and its way of life – a way of life which for almost 200 years has opened its doors to people from the four-corners of the earth who yearned to "breathe free." People who yearned to live where an individual can dare to achieve great things on his own volition – where a radio amateur can even begin a business enterprise out of a hobby and help to nurture its growth down through the years to a world famous corporation, Zenith Radio.

World Radio History

FROM AN ALBUM

PICTORIAL HISTORY OF ELECTRONICS



Zenith Radio Corporation

FIRST KNOWN RAILROAD RADIO, this 1919 Z-Nith radio-telegraph equipment dispatched N. C. & St. L. trains. It was designed and built by the fledgling radio manufacturing company, Chicago Radio Laboratory, founded by Karl Hassel and R. H. G. Mathews. The transmitting and receiving equipment was installed at Tullahoma, Tennessee, and Guntersville, Alabama. This communication "first" was to be one of many for CRL and for its successor, Zenith Radio Corporation.

Westinghouse Electric Corporation

In order to meet the demands of its growing program service the famous Westinghouse radio station KDKA employed one of the world's first full-time radio announcers, a young electrical engineer by the name of Harold W. Arlin. He was born in La Harpe, Illinois; schooled in Carthage, Missouri; and was graduated from the University of Kansas. He received honorable mention for his work as an announcer in both the 1924 and 1925 Radio Digest Gold Cup Awards, and he was an incorporator and first vice president of the Radio Announcers of America which was formed in 1925.

Zenith Radio Corporation

This print from an old photograph shows a radio operator receiving news dispatches over the famous long-wave radio set designed for the Chicago Tribune by Karl Hassel and R. H. G. Mathews of the Chicago Radio Laboratory. CRL manufactured equipment under the trade name "Z-Nith" which later became Zenith Radio Corporation. This radio set enabled the Tribune to receive news dispatches about the proceedings of the post-World War I Versailles Peace Conference directly from a long-wave radio station in France, thus, scooping their competitors by 12 to 24 hours. Their competitors were receiving their news dispatches via the congested transatlantic cable.

World Radio History

Illustrated History of the Vacuum Tube

A new chapter in the history of communications began with DeForest's invention of the three-element vacuum tube in 1906, and it paved the way for many new developments in electronic technology

PART ONE

by Robert G. Middleton

Fig. 1 An Edison carbon-filament lamp.

Fig. 2 A Fleming valve, used by the Marconi Co.

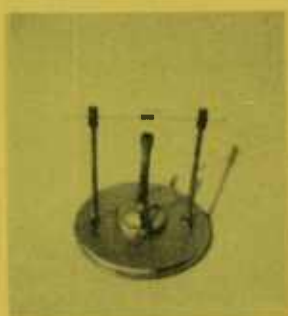


Fig. 3 A flame detector.

Fig. 4 A DeForest Ultraudion.

With the invention of the triode vacuum tube, an exciting new era was opened up in the science of electronics. The vacuum (or electron) tube is an outgrowth of the incandescent lamp, invented by Thomas Edison in 1883. Fig. 1 shows an early Edison lamp, manufactured by the Heisler Electric Co. These lamps employed a carbonized paper strip filament, and a Cooper Hewett two-prong base.

The Edison Effect

In 1884, Edison discovered that if a metal "wing" was placed near the filament in an incandescent lamp, this plate became negative and a small current flowed in an external circuit. Edison also noted that the current was greater when a battery was used to make the "wing" positive. At this time, he was interested only in lamp operation and efficiency. Therefore, application of the Edison Effect to wireless (radio) technology was made by another inventor.

The Fleming Valve

Prof. Fleming, of London, was aware in 1904 of Edison's discoveries. Since the Edison Effect was increased when the "wing" was positive and was cancelled when the "wing" was negative, Fleming reasoned that this electron device would operate as a radio-frequency rectifier, or detector. Experiment quickly proved his theory, and the Fleming Valve was born. Fig. 2 shows an early Fleming Valve, manufactured by the Royal Ediswan Co. in England.

Today, we call this type of tube a diode. The Fleming Valve provided an advantage over the preceding crystal detectors in point of stability. That is, a radio receiver with the new diode relieved the operator from the necessity of searching a crystal for a sensitive spot with a catwhisker. Marconi quickly adopted the Fleming Valve in his receivers. It should be noted that the new diode provided as good, but no better reception than a crystal detector when the latter was in proper adjustment. Therefore, inventors continued the difficult search for a supersensitive detector.

The DeForest Triode

On this side of the Atlantic, various wireless pioneers were hard at work on the detector problem. Gas lighting was in general use, and Lee DeForest had Welsbach gas mantles in his laboratory. He noticed in 1900 that the gas light was dimmed when he operated a spark coil nearby. Following up this clue, DeForest invented the flame detector, as exemplified in Fig. 3. It consisted of two wires leading into the flame of a Bunsen burner. The lower wire carried a capsule of salt. In operation, the salt gradually vaporized and gave the flame a bright yellow glow. Although the flame detector was inefficient, it

(Continued on next page)

NOTE: Due to typographical errors in our November/December 1971 issue, this article is published in this issue with corrections.

World Radio History

Fig. 5 An Audion control cabinet.

Fig. 10 The Myer's tube.

Fig. 13 French army triode, manufactured by the Moorhead Co.

Fig. 6 The DeForest Audiotron.

Fig. 11 An early Moorhead tube.

Fig. 7 The Weagant valve.

Fig. 12 Another variety of Moorhead tube.

Fig. 8 The Welsh peanut tube.

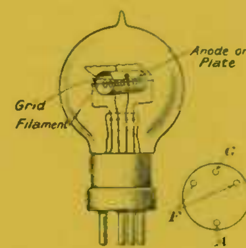


Fig. 14 Another version of the Moorhead design.

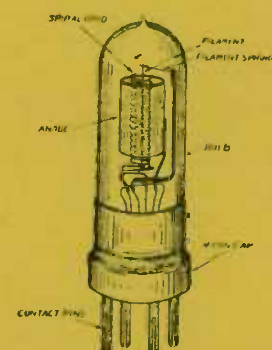


Fig. 15 Still another version of the Moorhead design, produced by British manufacturers.

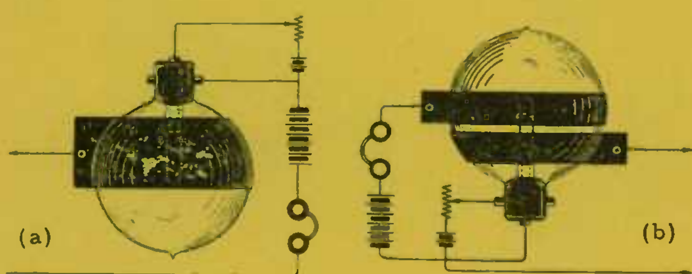


Fig. 9 Examples of Shaw tubes. (a) Diode. (b) Triode.

HISTORY OF THE VACUUM TUBE

(Continued from preceding page)

served as a useful purpose by directing DeForest's efforts to research on hot filaments and the Fleming Valve.

DeForest arranged with the McCandless Co. to make up various modified carbon-filament lamps and valves. In 1906 he discovered that when a wire grid was placed between the filament and "wing" of a Fleming valve, that greatly improved radio reception was obtained. That is, the first triode was operating as an amplifier, in addition to its detector action. DeForest named his triode the Audion. In 1909, two "wings" and two grids were utilized, and the new design was called the Ultraudion. Fig. 4 shows an early Ultraudion, manufactured by the McCandless Co. These tubes had an appreciable gas content, and were termed "soft" tubes. Although they were efficient detectors, the B+ voltage was quite critical.

The amplifying property of the triode was put to immediate use, and DeForest produced the first transformer - coupled amplifiers. Fig. 5 shows the appearance of an early audion control cabinet. The triode was quickly adopted by the Marconi Co., and by the U.S. Army and Navy. In 1915, the spherical audion was changed into a tubular form. Fig. 6 shows an early tubular audion, called the Audiotron. It employed a cylindrical "wing" and grid, with two filaments. Only one filament was operated at a time, so that the other could be switched into operation in case the first filament burned out.

Other Types of Triodes

Many attempts were made to devise triodes that did not infringe on the DeForest patent. Some of these variations were operable, although none were as good as the audion and audiotron. Roy Weagant, a development engineer with

World Radio History

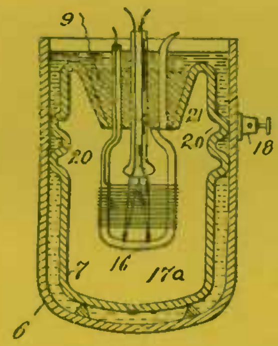


Fig. 16 Plan of a fluid-cooled transmitting tube designed by DeForest.

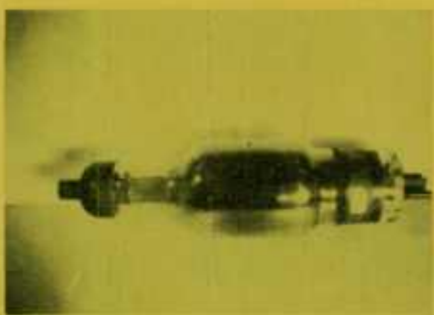


Fig. 17 The UV-204 tube used in early radio broadcast stations.

Fig. 18 Western Electric VT-1 triode.

Fig. 19 Construction of the VT-1 triode.

Fig. 20 Western Electric VT-2 triode.

Fig. 21 The RCA WD-11 triode.

Fig. 22 The UV-199 peanut tube.

Fig. 23 The DeForest battery tube for portable receivers.

Fig. 24 The UX-225 was the first cathode-type tube.

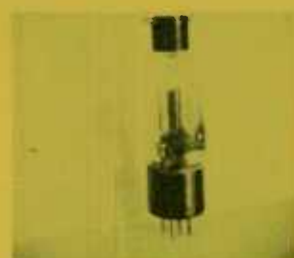


Fig. 25 The Kellogg AC triode.

Marconi Co. devised the triode shown in Fig. 7. This was basically a diode with the filament at one end and the plate at the other end of the tube. A metal collar around the outer surface of the tube, and positioned between the filament and plate, served as a control electrode, or grid. Weagant valves were also produced in large sizes, and used in undamped-wave and radiotelephone transmitters. As was inevitable, lawsuits arose between Marconi and DeForest .

As late as 1923, variations of the Weagant valve were being manufactured. For example, the Welsh peanut tube shown in Fig. 8 employed a coil of wire around the outer surface of the tube as a control electrode for a Fleming-valve arrangement. This tube was merchandised only as a detector, and no claims were made for amplifier action. The anode in the Welsh peanut tube consisted of a pointed wire. It was operated with about 150 volts on the anode. Another ephemeral design, called the Shaw tubes, is depicted in Fig. 9. These were carbon - filament Fleming valves, with only the filament enclosed in the glass bulb. The plate and control electrodes were copper bands around the outer surface of the bulb.

Canadian Triode Design

The DeForest Audiotron was unbased, as was the Weagant valve. In Canada, however, the Myer's Co. manufactured an audiotron with a base at each end, as seen in Fig. 10. The tube was inserted into a socket with spring clips, much like a fuseholder. This tube had only one filament, and was somewhat smaller than the audiotron. It was also a hard tube—that is, it was highly evacuated. The hard tube had an advantage as an amplifier, although the soft audiotron provided better detection sensitivity.

World Radio History

Marconi-DeForest Tube Litigation

In 1914, the Marconi Co. filed suit against the DeForest Co., alleging that the DeForest patent was invalid, being an infringement of the Fleming patent. The Weagant valve was opposed by DeForest, as being an infringement of his triode patent. Injunctions were issued at this point, which prevented either company from manufacturing three-element tubes. However, with the urgency of World War I building up, a legal truce was provided to permit tube manufacture for the Army and Navy.

Later in 1919, the Moorhead Co. was licensed by Marconi to manufacture Fleming valves, and was licensed by DeForest to manufacture audions. Several varieties of triodes were produced, and "sold only for amateur and experimental use." These were the first brass-base tubes, as seen in Fig. 11. The base carried the Marconi insignia and Fleming patent numbers on one side, with the DeForest brand and patent numbers on the other side. Another variety of the Moorhead tube is shown in Fig. 12. This triode had a U-shaped plate enclosing a wire grid supported by small glass tubes.

During World War I, Moorhead manufactured tubes for the Allied armies and navies. The tube shown in Fig. 13 was produced for the French army. Another version, depicted in Fig. 14, had its elements mounted horizontally, instead of vertically. Note also in Fig. 14 that the European tube base featured slotted pins which plugged into matching socket holes. British tubes were manufactured with the same basic arrangement of Fig. 13, except that a tubular glass envelope was used, as depicted in Fig. 15.

Transmitting Tubes

DeForest pioneered radio telephony by means of vacuum tubes, and was as concerned with transmitting tubes as with receiving tubes. His large early versions of the audion were termed the Oscillion. In attempting to provide high-power operation, DeForest recognized that air cooling becomes insufficient. Therefore, he introduced the fluid-cooled transmitting tube, depicted in Fig. 16. The space between the metal shells 6 and 7 is filled with mercury or oil. Note that shell 7 is the operative plate, it is corrugated in region 20, to provide more surface where maximum heat dissipation is required.

Early radio broadcast stations used air-cooled transmitting tubes, such as the UV-204 shown in Fig. 17. This tube operated at 2,000 volts, drew 0.25 ampere of plate current, and was rated for a quarter kilowatt of rf output. Broadcast stations commonly operated two or more of these tubes in parallel to obtain increased radiated power. The same tube type was also used in Heising modulator arrangements. Although the early transmitting tubes employed tungsten filaments, the later versions utilized thoriated tungsten. The UV-204 tube was first manufactured by the General Electric Co. for the navy during World War I. GE termed this type of tube a Pliotron. The GE diode tube types were termed Kenotrons.

Western Electric Tubes

The Western Electric Co. manufactured triodes which were widely used in army and navy equipment during World War I. Their VT-1, well known to Signal Corps veterans, is shown in Fig. 18, and its construction is depicted in Fig. 19. This was a comparatively rugged tube, well suited to service in the field. It was used primarily as a detector, and a larger tube, the VT-2 shown in Fig. 20, was used as an amplifier. In this era, nearly all amplification was provided at audio frequencies. However, a few receivers provided amplification at radio frequencies, also.

Battery-Operated Tubes

In the early 1920's, all receiving tubes were battery operated, and heavy storage batteries were used for the filament supply. The market for a tube that could be operated from a dry cell was obvious, and RCA eventually introduced the WD-11 tube, shown in Fig. 21. Its filament was energized by a No. 6 dry cell, and its plate was powered by a B battery consisting of about 30 flashlight cells. This tube made portable radio receivers practical for the first time. In the attempt to further reduce the weight of portable receivers, RCA next introduced the UV-199 peanut tube, shown in Fig. 22. This tube had a filament that could be operated from two flashlight cells. It became highly popular in portable receivers.

In this era, the DeForest Co. also manufactured the 3-volt dry-cell audion shown in Fig. 23. This tube was used in portable radio receivers of the reflex type. In a reflex circuit, the tube first amplified the incoming signal at radio frequency; the signal then passed through a detector, and was finally amplified again by the first tube at audio frequency. Thus, the tube did double duty. However, the efficiency of the early reflex circuits was rather poor, due to the extensive use of untuned radio-frequency transformers.

Early AC Tubes

Although battery operation was essential in portable receivers, this was a disadvantage in home receivers. Batteries required replacement at intervals, and this was a difficult job for inexperienced persons. For example, many filaments were burned out because a B battery was confused with an A battery. Polarities were also an excessively technical consideration for housewives and nontechnical people in general. Therefore, much effort was given to the development of tubes that could be powered by means of transformers operating from house current. It gradually became evident that exposed filaments were not entirely suitable for AC operation.

To reduce residual hum satisfactorily, the cathode-type of tube was introduced. Probably the first to make a commercial appearance was the UX-225 shown in Fig. 24. This tube featured a brass base at its top for connection to the AC heater line. Thereby, AC fields were kept at a maximum distance from the grid and plate pins in the bakelite base. The next tube in this category to make its appearance was the Kellogg triode, shown in Fig. 25. It also featured a separate base at the top for connection to the heater line. At this point, the groundwork had been laid for development of the more modern types of electron tubes.

World Radio History

NEWS ORBIT AROUND THE WORLD OF ELECTRONICS

POLUTION CONTROL

New alarm system hits pollution

Westinghouse Electric Corporation has developed a new alarm system—not for burglars but for pollution.

Manufactured by the company's meter division, the automated system monitors and records weather and pollution data, and it can "blow the whistle" when pollutant emissions reach a predetermined level.

And by computer analysis of meteorological and pollutant data, environmental "profiles" can be constructed that can help avert pollution episodes in the future.

The environmental monitoring system is designed for use by industries and utilities which will be required to record environmental data at their facilities. It can also be used by government agencies to form the backbone of local, state, and regional environmental measuring and control programs, according to M. J. McDonough, Westinghouse executive vice president, transmission and distribution.

"We believe that this system will play a major role in bringing about the cleaner environment of the future," Mr. McDonough said. "This system enables environmental agencies to determine where pollution is, assist in determining where it is coming from, how bad it is at any given time, and ultimately the likelihood of a serious pollution episode occurring."

In addition to monitoring and recording pollution and weather data at the site, an alarm in the system can automatically send a signal to an environmental control center when a sensor is reading concentrations that exceed a predetermined level.

And the system also has the capability of being "read" remotely to determine a specific pollution level at a given location. Thus, an environmental control center can check pollution levels at various locations at will, using a telephone and teletype reading terminal.

The environmental monitoring system can sense and record such pollutants as sulphur dioxide, oxides of nitrogen, hydrocarbons and particulates. Weather inputs include rainfall, solar radiation, wind direction and velocity, humidity and barometric pressure. In addition, water pollution data can be gathered, such as temperature, water flow, salinity and dissolved oxygen content.

The system can be used in the same manner to control river "sags," when pollutant concentrations hamper the ability of a body of water to support life.

The heart of the environmental monitoring system is a slow-speed tape recorder, which can record as many as three channels of weather or pollutant data simultaneously, Mr. McDonough explained. A fourth channel records time. Information is fed into each channel from a sensor measuring a particular type of weather condition or pollutant. Where more than three parameter records are needed, additional recorders are used.

Under the clean air act of 1967 and the amendments of 1970, potential polluters must monitor air quality, keep records of these data, and make reports to state air pollution control agencies on the effect of their operations on the environment.

MEDICINE

New device cuts x-ray exposure

A self-contained x-ray image intensifying system that can replace the fluoroscopic screen and reduce x-ray exposure to patients and doctors has been introduced by Raytheon Company's Machlett Laboratories.

The easily-installed system produces sharp pictures with excellent contrast. Due to the light amplification, the image can be viewed in a normally lighted room. The new Machlett Dynaview is easily adapted to any type of fluoroscopic or spot film equipment presently in use, making it practical to use image intensifying techniques to replace all fluoroscopic examinations.

Packaged within the housing is a complete solid-state power supply so that the necessary high voltages are all contained within the equipment. The only external electrical connection is a standard 115-volt line. No adjustments are necessary at the user's location due to the integration of the supporting electrical equipment.

A built-in optical system employing lenses and mirrors permits the radiologist to view the x-ray from a comfortable attitude in a normally lighted room. An apron of bottom plates assures the containment of x-rays when modifying existing spot film and fluoroscopic equipment.

The Dynaview system is supplied with an overhead counterbalanced suspension unit to support the system and enable it to be moved easily over the length of the patient's table or rolled clear of the table to facilitate other procedures.

MANAGEMENT

New SPR Director at Westinghouse

Eugene Rodgers has been appointed director of science public relations for Westinghouse Electric Corporation, succeeding Harry R. Gail, who retired.

Mr. Rodgers has been public relations manager for the Westinghouse Research Laboratories. His responsibilities will now include other science-related public relations functions, such as the Westinghouse Science Talent Search and the AAAS-Westinghouse Science Writing Awards.

Mr. Rodgers earned a B. S. degree in chemistry from Villanova University in 1961, and then studied the history of science and completed a two-year training program in science writing at the University of Wisconsin. He served as public information officer for the U.S. Antarctic Research Program from 1963 to 1965, and was a freelance writer prior to joining Westinghouse in 1967.

World Radio History

(Continued from page 23)

NEW PRODUCTS

New solid-state SW receiver

New from Radio Shack is the SX-190 solid-state 11-band SSB/CW/AM receiver, designed for general communications and shortwave listening.

According to Radio Shack, this receiver incorporates professional-quality design features and latest state-of-the-art circuitry for greater sensitivity and selectivity to satisfy even the most critical shortwave enthusiast.

The SX-190 employs a sensitive dual-conversion circuit with 11 crystal-controlled bands. The receiver is supplied with crystals for coverage of popular frequencies on 9 bands. Two bands are left blank so that crystals may be ordered for special portions of the 3.5-10 MHz and 10-30 MHz bands.

With the crystals provided, the SX-190 covers the popular 49, 41, 31, 25, 19 and 16 meter international shortwave frequencies, 80, 40 and 20 meter Ham bands. WWV National Bureau of Standards time broadcasts and Citizens Band radio.

Among the receiver's features are a preselector to aid reception of weak stations and a built-in Q-multiplier which eliminates interference from adjacent stations. Built-in 25 and 100 kHz crystal calibrators help maintain dial accuracy, which is given as ± 200 Hz.

An illuminated S-meter shows signal strength and aids tuning. Automatic gain control circuitry prevents blasting and fading of signals, while an automatic noise limiter circuit reduces pulse type interference.

TRADE SHOWS

Expo in Houston for N.E.W.

The National Electrical Week Southwest Electrical Exposition, the first regional electrical power apparatus, electrical construction materials, lighting and utility-type product show ever held in the southwest U.S., is scheduled here for Feb. 8-10, 1972, at the Albert Thomas Convention & Exhibit Center.

Sponsored by the Houston Electrical League in conjunction with Houston Lighting & Power Co., the show will be a unique marketplace for the nation's leading suppliers of industrial, commercial and residential power equipment. It will also mark the Houston League's observance of National Electrical Week.

(A direct employer of some 3 million Americans, the electrical industry each year sets aside a week to celebrate the anniversary of Thomas A. Edison's birthday. 1972 N.E.W. dates are Feb. 6 through 12.)

Plans now call for the exposition to be held every two years during National Electrical Week.

"Based on the booths already sold, we expect between 150 and 200 exhibitors at the three-day show," said Jack M. Cobb, N.E.W. Southwest Electrical Exposition general chairman.

The displays will include underground and overhead transmission equipment, electrical motor controls and drives, transformers, wiring and conduit, and lighting equipment.

The Houston Electrical League will use the proceeds from the exposition for a scholarship fund to assist young people in pursuing studies leading to a career in the electrical industry.

SUMMER STUDY

Electronics for scientists

An intensive course in electronics for scientists who use electronic instruments will be given for the 13th time next summer at the University of Illinois at Urbana-Champaign.

A $63,214 National Science Foundation grant will support the course.

For 20 of 60 persons attending, the course will include special instruction on computer interfacing and completely automated instrumentation. This will be for persons who have completed the general course or had similar training.

Prof. Howard Malmstadt, who has presented the annual summer courses since 1960, is a chemist who during World War II worked with Navy radar. When he returned he found scientists facing an increasing number of electronic tools whose workings were completely mysterious to them.

To take out the mystery, he prepared a course, writing a text with Christie G. Enke, then a graduate student at Illinois and now a professor at Michigan State, and developing special laboratory-quality equipment manufactured by the Heath Co. of Benton Harbor, Mich.

Through summer courses at which teachers from other schools are sponsored by the National Science Foundation, the course has been spread over the nation. A small number of scientists from industry, medical centers and other non-teaching organizations also are admitted each summer.

During the regular school year the course is offered at Illinois to undergraduate, graduate and postdoctoral students.

Over the years it has kept up with changes in electronic instrumentation. The new work on computer interfacing and completely automated instrumentation was added this year.

OCEANOLOGY

Sub makes trip through big pipe under mountain

A Florida-built submarine, it was disclosed today, may have achieved a world "first": a trip beneath a mountain.

Vincent R. Bailey, executive vice-president of Perry Oceanographics, Inc., of Riviera Beach, Florida, said one of the company's submarines, the Shelf Diver, made the trip inside a pipe, 15 feet in diameter, which carries fresh water from the French Alps to the city of Marseilles, in southern France.

The inspection-demonstration trip, he said, began at the French village of Rean, where the pipeline empties into a settling basin. The four-man submarine, which is 10 feet high

(Continued on next page)

World Radio History

and 6 feet wide, went one kilometer (approximately ⅝th of a mile) into the pipe and inspected the tunnel's inner surface at a point beneath a mountain approximately 1,000 feet high. So far as is known, Bailey said, such inspection with a submarine from inside a pipe has never been done before.

The submarine entered bow-first, Bailey said, and after an hour of inspection backed out under its own power. The craft was piloted by James Dudley of Hypoluxo, Florida. A Perry engineer, Mitch Michaud of Riviera Beach, Florida, operated safety-check hydrophone voice communications with the submarine from station near the tunnel entrance. The trip into the tunnel required 50 minutes; the exit trip lasted 70 minutes. The Shelf Diver, which was built in Riviera Beach in 1968, is on permanent station in Europe.

Going into the tunnel, Shelf Diver bucked a half-knot current. When the sub backed out it had less maneuverability and from time to time banged against the sides of the tunnel. Some minor damage to the sub resulted. In event of serious mishap, officials said, the tunnel could have been drained dry in six hours. The sub's onboard life-support equipment could have operated for about 48 hours.

Charles Polk chairs Ocean 72

Professor Charles Polk, the University of Rhode Island's electrical engineering department head, has been selected as chairman of the technical program committee of OCEAN 72, an international conference on engineering in the ocean environment scheduled for 13-15 September at Newport, Rhode Island. The third annual meeting is co-sponsored by the Oceanographic Coordinating Committee (OCC) composed of 16 member Groups of the Institute of Electrical and Electronics Engineers (IEEE) and by the Institute's Providence Section. The conference steering committee is composed of representatives of southeastern New England organizations supporting the conference including the United States Naval Underseas Systems Center, the Submarine Signal Division of Raytheon Company, Brown University, the Woods Hole Oceanographic Institute, and the Universities of Rhode Island and Southeastern Massachusetts.

OCEAN 72 will emphasize discussion of advanced development and research in electrical and electronic engineering applicable to the marine environment. While presentations on state-of-the-art hardware is not a direct concern of the conference, analysis is desired of marine related systems where electrical and electronic engineers can make major contributions. Subject areas for which papers are solicited are: Navigation, guidance and control; Power generation and transmission; Communication, ranging and imaging systems; Data collection and signal processing; Oceanographic and pollution monitoring instrumentation; Remote sensing; Underwater acoustics and electromagnetic phenomena, including optics; material for electrical and electronic applications in the marine environment; and Life-support and biological instrumentation systems.

YESTERDAY AND TODAY

Today's radio is a better buy

Antique radios are prize acquisitions today.

Collectors are paying top dollar for radios characterized by an era of crackling static, big black round dials and fine furniture console woodwork.

This year has cultivated a new breed of the radio enthusiast. He's the tinkerer refinishing a 1920 Atwater Kent or polishing up the fine walnut wood of a 1928 Zenith console.

This new breed marked the trend of 1971 as the "Year of Nostalgia."

"The most noteworthy trend today, however, is that radio provides more features for less than ever before," according to J. E. Brown, senior vice president-engineering of Zenith Radio Corporation and a member of the elite Antique Wireless Association.

"For considerably lower cost, sets today feature illuminated digital clock dials, down-firing speakers dispersing sound 360 degrees, wake-up and automatic shutoff control and pocket portability," Brown said.

Some radios recharge themselves overnight. Many fit into small spaces, record directly to tape, have large clock faces for easy viewing and still offer fine furniture styling plus modern combinations of stereo phonograph, tape and TV equipment.

Other improvements include a hidden FM antenna, as featured on a new Zenith pocket portable FM/AM set, the Royal B21, which virtually eliminates the need for a telescoping "whip" antenna on battery power.

Zenith also offers its famous Trans-Oceanic multiband receiver, now in its 30th year of production but modified to receive 11 bands—six more than the first 1941 model. Zenith offers 42 radios in the 1972 line—75 per cent featuring the FM band.

"What has happened since those Golden Days of radio," Brown said, "has been tremendous technical progress resulting in lower prices as well as design advances."

Consider Zenith's 1928 Spanish radio console — a masterpiece of handcrafting capturing the elegance of old Spain. It sold for $2,500.

In 1937, prices came down to $750 for the top-of-the-line Stratosphere console with a decorative white porcelain cat at the base, big black tuning dial and solid walnut, lauralwood and elm burl inlay.

One of the most valued antique sets is the first portable radio manufactured by Zenith in 1924. It looked much like a suitcase and sold for $200. It was another measure of progress that 10 years later a better portable sold for about $20.

In 1926 Zenith manufactured the first AC power radio which eliminated the need for cumbersome and often messy console radio batteries.

"Collectors generally agree that the old sets, built prior to 1930, are the most valuable or antique," Brown said. "These are milestones because technical 'firsts' progressed just as fast as styling."

TRAFFIC CONTROL

New automated freeway system

Six-foot squares of sensing wires buried in the roadbed . . . an electronic eye watching down from the sky . . . a voice by the side of the road . . . and a fleet of tow trucks racing to the rescue. These are some

(Continued on page 26)

NEWS ORBIT

(Continued from page 25)

AUTOMATED FREEWAYS

of the components of a new California Division of Highways' system to relieve freeway tieups caused by traffic accidents.

The motorist, who often feels that the state opens a fast freeway and then leaves him there all by himself to cope with traffic problems, will soon lose his feeling of abandonment under the new Los Angeles Area Freeway Surveillance and Control Project. The system is considered to be the first step toward a fully automated freeway system.

The general concept of the California Division of Highways' Freeway Operations Department is to develop and put to use electronic hardware that will provide safer and more efficient use of freeways.

One phase is to try to minimize the tieups that result when car accidents, truck turnovers, stalled vehicles, fires and other "random events" occur on a busy freeway. Such incidents account for about 50% of the congestion today, equalling that caused at predictable known sites that normally jam up during peak traffic hours.

To ease freeway congestion, a helicopter borne "eye in the sky" will begin this month to aid in guiding Los Angeles motorists through the world's most intricate traffic complex. The closed circuit television system is one element of a real-time surveillance, control and early warning system that will help keep moving the 700,000 vehicles that daily travel the Santa Monica-Harbor-San Diego Freeway triangle.

Some bottlenecks have been alleviated by restriping or building added lanes. Timing vehicle entry at critical on-ramps has also eased access by metering. The closing of a few ramps has also improved traffic flow. But the stubborn problem of "non-recurring" incidents brings many other factors into play.

To learn quickly exactly where such incidents occur in real-time sequence, the pilot project has just been completed on a 42-mile loop on the three major freeways: for 12.7 miles on the Harbor Freeway, for 16.6 miles on the San Diego, and for 12.7 miles on the Santa Monica.

The surveillance system includes squares of wire that are buried in the roadbed to provide instant data about how many cars are passing a given point, and how long they are staying over that point, which indicates the volume and density of traffic.

Telemetering equipment has been installed to relay that information to the Control Center on Vermont Street near downtown Los Angeles. The computer instantaneously analyzes this input and transfers the data to an information display map of the freeway loop.

Speeds and densities of traffic at stations ½ mile apart are indicated on the map by red, green and yellow lights. Trouble or unusual incidents are indicated by a flashing red light at the appropriate spot on the map.

The push of a button will provide the actual count and density at several stations in the area and tells if the incident is blocking lanes, how many are blocked and how congestion is stacking up behind the trouble spot.

DEFENSE

Navy destroyers get computerized command-control

Digital display systems for use aboard a future fleet of 30 U. S. Navy Spruance-class destroyers are now in production at Hughes Aircraft Company's ground systems group here under a $30.1-million sub-contract from Litton Industries, it was announced today.

The systems, which are designed to provide Navy personnel with console-displayed information from the destroyers' computerized command, control and communications systems, will be delivered to Litton's data systems division, Van Nuys, Calif., for integration into the ships' electronic systems.

Clare G. Carlson, Hughes vice president, said the systems are part of the Naval Tactical Data Systems (NTDS) which provide instantaneous presentation of the action within tactical combat zones. (The Navy designates the systems as AN/UYA-4 data display groups.)

Each NTDS system uses radars, computers and communications equipment to gather, process and exhibit data on Hughes display consoles. Within seconds, NTDS can evaluate a potential threat, assign and control countering weapons and perform other command functions for a single ship or an entire fleet, Carlson said.

The NTDS displays will supply target information for the ships' armament, which includes two 5-inch guns, Sparrow missiles, standard and rocket-assisted projectiles and anti-submarine torpedoes and rockets.

Defenses posed to sub-launched missile threats

Can the United States protect itself against missile attack launched from submarines hidden underwater close off any point of its 12,000 miles of coastline?

Finding answers to the possibility is the goal of a team of specialists at Hughes Aircraft Company's ground systems group, working under the direction of a joint U. S. military steering group.

Hughes project manager Charles J. Thompson said the object of the anti-submarine-launched ballistic missile defense study is to examine the potential attack roles of a possible enemy submarine fleet equipped with a nuclear missile capability. Specific defense solutions will then be recommended.

"The defense problem is unique," Thompson said. "With a land-based enemy missile attack, launch areas can be located and plotted, and defensive plans can be prepared against it. It is a different problem with an enemy missile-carrying submarine that can lurk undetected almost anywhere in offshore waters, from where the missile's flight time to the target is much shorter."

The study, now in its second phase, is scheduled to continue through early 1972. The objective of the study is to create a catalog of the most urgent anti-submarine-launched ballistic missile defense problems and solutions.

"It's a never-ending game of reaction. Threats change and defense technology changes. There probably is no one defense system that is totally undefeatable," Thompson explained, "but our defense objective is deterrence. Our goal is to evolve technologies so effective that an enemy will have little to gain in building offensive weapons and even less to gain in using them."

World Radio History

Capacity—Operated Relay

This transistor version of the capacity—operated relay makes a versatile device for use as a burglar alarm, novel store window display, and other control duty

Special Science Project

The transistor version of the capacity-operated relay makes possible a unit that surpasses earlier tube versions. Current consumption is a fraction of former values and the circuit lends itself to small size, if desired. The device has been used for burglar alarms, novel store window displays and other control functions. Its important characteristic is an ability to energize a relay when a hand touches a sensitive antenna wire. In the case of the burglar alarm, the wire is attached to a screen, doorknob, or other surface to be protected. When contact is made, a remote indication such as a lamp or bell is triggered by the relay.

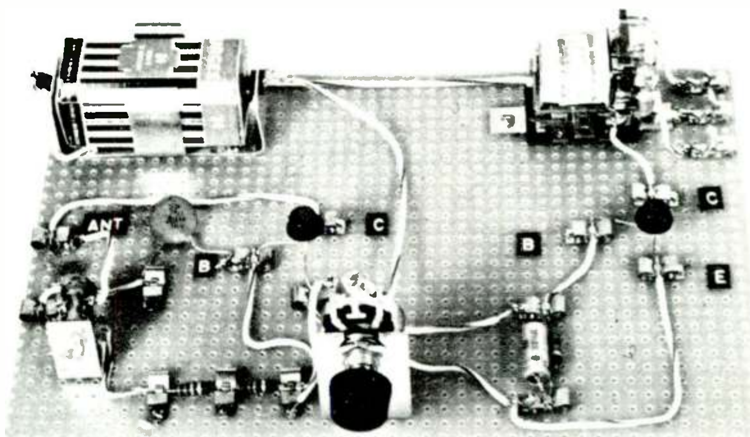


Fig. 7-2, Capacity-operated relay.

PARTS LIST

R1—22K ½-watt resistor (926 B 1800 $ .12)
R2—68K ½-watt resistor (962 B 1800 $ .12)
R3—50K carbon potentiometer (271-1716 $ .79)
R4—1K ½-watt resistor (962 B 1800 $ .12)
C1—150-mmf disc capacitor (926-4532 $ .18)
C2—.01-mfd disc ceramic capacitor (926-4517 $ .18)
C3—50-mfd 12-volt electrolytic capacitor (755-3116 $ .71)
L1—Tapped transistor oscillator coil (Miller 2020 or equiv.)
B—6-volt transistor-type battery (737-0720 $1.50)
X1, X2—2N322 transistor ($ .64 ea.)
RY1—SPDT relay with 500-ohm 9.0 ma coil (917-0511 $5.66)
Misc.—Circuit board (276 B 1391 $ .99; 2 pkg. clips 270 B 393 $ .69/pkg. of 8); battery bracket; potentiometer bracket

Prices subject to change.

CIRCUIT OPERATION

The heart of the system is a pair of transistors connected as shown in Fig. 7-1. Transistor X1 is wired as an RF oscillator which generates a frequency according to the adjustment of tuning coil L1. The coil forms a tuned circuit with the 150-mmf capacitor, C1. As in any oscillator circuit, there is a feedback path to return a portion of the output energy back to the input. This is the electromagnetic coupling which exists between the large and small sections of the tuning coil. The base of X1 is across the smaller winding and driven by alternating current circulating in the tuned circuit.

The over-all purpose of the oscillator is to establish a signal which is responsive to the touch. If a hand contacts the antenna wire, the capacitance of the human body shunts radio-frequency energy from the tuned circuit to ground. The net result is that oscillations cease; the feedback path to the base of the transistor is discontinued. Instead of coupling into the base circuit, feedback is lost to ground through the hand.

Assume that the oscillator is functioning normally, with no interference from body capacity. The current flow through X1 produces a voltage drop across emitter resistor R4. Note that the base of the other transistor, X2, is also tied to this resistor. Any fluctuations appearing at this point act to change the current flow in X2. As oscillation occurs, the polarity of voltage at the emitter resistor is such that current forward biases the base circuit of X2. Amplification in the second transistor occurs, and the relay coil in its collector circuit is energized. Thus, relay contacts remain closed when the oscillator functions normally.

However, if the oscillator ceases to operate, the voltage produced across R4 is lost. Transistor X2 loses base bias and its collector current drops sharply. The net result is that the relay is de-energized. Since the relay is a single-pole double-throw type, the proper contacts may be selected to actuate an external alarm circuit.

The capacity relay circuit is refined with the addition of potentiometer R3. This permits oscillator bias to be varied for optimum relay sensitivity. Note its connection between the positive battery terminal and the base of X1.

CONSTRUCTION

The suggested chassis layout for the capacity-operated relay is shown in Fig. 7-2. A complete Parts Lists follows.

The capacity-operated relay can be built on a piece of perforated board or similar material. Slips, or other tie points, are required for the support of the transistor leads as well as component

(Continued on next page)

Reprinted by permission from "Understanding Transistors and Transistor Projects." Copyright 1968 and 1971 by Allied Radio Shack Fort Worth, TX 76107

World Radio History

COMPACITY-OPERATED RELAY

(Continued from preceding page)

leads.

Antenna and ground connections required for the device are shown in Fig. 7-3. A length of hookup wire, several feet long, is attached to a doorknob or window screen. The ground is a lead running from the positive battery terminal to a cold-water pipe or the screw which holds the cover plate of a wall outlet.

The relay connections may be figured out with the aid of an ohmmeter if the project is not built from the lab kit, as illustrated here. First, the coil winding is determined by measuring across the various lugs until a resistance of approximately 550 ohms is found. The other three terminals are contacts indicated by the letters A, B and C in the schematic. Place the ohmmeter across various terminals and note which pair displays zero resistance on the ohmmeter. These are the normally-closed contacts. Next, operate the movable contact of the relay by pressing it against the remaining terminal. As this is done, find the terminal pair that indicates zero resistance. There will be the normally-open contacts. The contacts used for the operation of an alarm device are the normally closed ones. (They correspond to A and B on the schematic.) The use of these contacts with an alarm bell is pictured in Fig. 7-4.

TESTING

The first trial with the completed unit begins by adjusting sensitivity control R3. Start with the knob in the most counterclockwise position and slowly rotate it to the right while watching the movable contact on the relay. (The bell should not be hooked up at this time it will ring continuously as initial adjustments are made.) Keep turning the knob until you see the relay contact move into its closed position. An audible click should be heard, too. During this process, the knob must be turned very slowly. In fact, best operation will result if you turn the knob a fraction of an inch each time and wait two or three seconds for the relay to react Once you have discovered the adjustment which just causes the relay to close, touch a finger to the antenna terminal. As this is done, the relay should drop out, then return as the finger is withdrawn.

If the circuit does not respond properly, it may be necessary to readjust the frequency of the oscillator. Try various settings of the coil knob, starting with the knob all the way in.

The functioning circuit may be explored with the aid of a VOM. First, the on-off action of the RF oscillator is examined by opening the collector circuit of X1 and reading current flow under varying conditions. The positive probe of the meter is clipped to the collector terminal, while the negative probe is attached to the disconnected wire. Set the meter range so a few milliamperes can be conveniently read on the scale. Note the amount of current flowing as the oscillator performs undistrubed. Now touch a finger to the antenna terminal; the flow should drop when oscillations cease. Restore collector connections and move the probes to the next test point.

Set the meter on its lowest voltage range, around 1.5 or 2.5 volts DC. Touch the negative probe to the top end of R4, and the positive probe to the lower end of the same resistor. When the oscillator is in operation, a low value of negative voltage should be indicated on the meter. This is the basis applied to the base of X2, and is responsible for its large current flow. When a finger is again touched to the antenna terminal, the voltage should drop. In effect, it goes in a more positive direction and removes operating bias from the base of X2.

Next, the current flow through X2, as controlled by the oscillator, is observed. Insert the meter probes in series with the collector, as before. Set the scale of the VOM to indicate approximately 10 milliamperes. When the oscillator is untouched, the reading should be somewhere near the top of the meter scale, nearly 10 ma. But touch the antenna lead and current drops down to nearly zero. The action of the relay coincides with the change in current flow. It, too, "drops out" under the influence of lowered collector current.

PUTTING THE RELAY TO WORK

Antenna and ground connections are made, as detailed earlier, to place the capacity-operated relay into service. The alarm circuit is connected to the relay terminals and checked as the antenna input to the oscillator is touched. You will notice that increasing the size of the metal object to which the antenna is connected increases sensitivity of the response. This is due to the larger area which exists between the hand and antenna lead. If circuit sensitivity is made very high, through careful adjustment of potentiometer R3, the alarm will "fire" with no actual contact between the hand and pickup point (knob, screen, etc.). Sufficient energy is transferred to ground by the large capacitance developed between the hand and a large metal object.

NOTE: This project is taken from "Understanding Transistors and Transistor Projects," Allied Radio Shack's handbook of transistor fundamentals. It may be purchased for 95 cents from Radio Shack Stores throughout the U. S. and Canada.

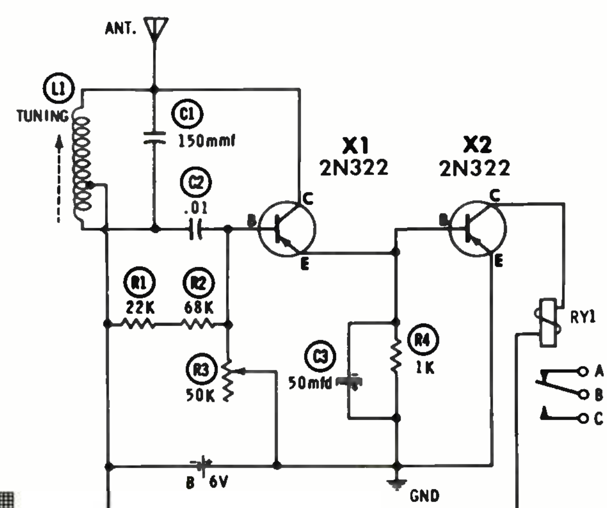


Fig. 7-1. Capacity-operated relay circuit.

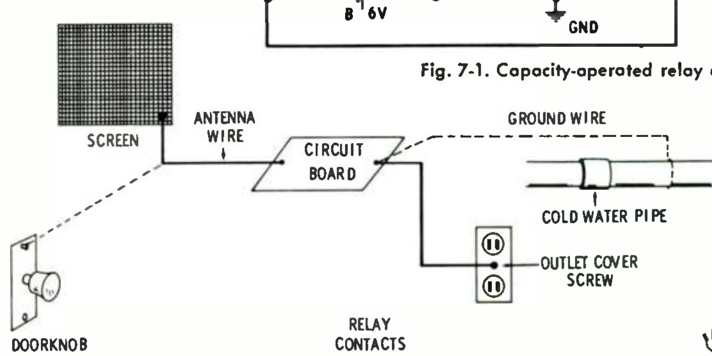


Fig. 7-3. Antenna and ground connections.

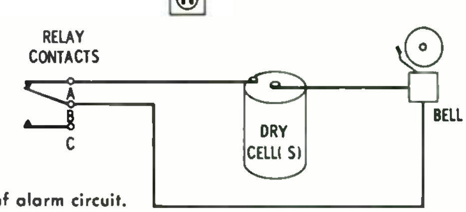


Fig. 7-4. Wiring of alarm circuit.

World Radio History

Build a Browning-Drake Receiver

In the early 1920s, when broadcasting was still young, it was great fun to spend the long winter evenings fishing for DX and trying to see how many stations could be logged in an evening on the popular Browning-Drake Receiver

By Art Trauffer

In the mid-1920's one of the most popular broadcast receiver circuits for the home constructor was the "Browning-Drake," developed by two Harvard University Engineering School Research Fellows, Glenn H. Browning and Frederick H. Drake. Basic kits for the construction of this receiver were manufactured by the National Company, Inc., Cambridge, Mass., and others.

As shown in schematic diagram (Fig. 1) the circuit consists of one stage of tuned-radio-frequency amplification, followed by a tuned detector having regenerative "feedback." The first tube not only acts as an amplifier but also as a blocking tube, preventing the neighbors from being disturbed by radiation from the regenerative detector. The regenerative detector not only acts as a rectifier, but the sensitivity and selectivity are greatly increased by feedback from "tickler" coil (L5).

To prevent troublesome oscillation in the trf stage, a very small variable capacitor (C5) was used to neutralize the inter-electrode capacitance in trf tube (V1). In other words, oscillation in the trf stage is prevented by balancing the internal capacity of tube (V1) with an external capacity (C5) allowing a feedback equal in effect but opposite in phase to the feedback through the tube. The tendency toward oscillation which would result from tube feedback is balanced by an opposite effect from the external feedback.

Most of the Browning-Drake sets also had two stages of audio frequency amplification following the detector, for loudspeaker operation, but in the project described in this article we use earphones only. An audio amplifier may be added if desired.

CONSTRUCTION

Since this is an experimental project, and most of the information is given in (Continued on page 31)

Photo by Art Trauffer

In the early 1920s, when radio broadcasting was still young, it was great fun to spend the long winter evenings fishing for DX and trying to see how many stations could be logged in an evening. Dial settings were marked in a station log book, and some fans tacked maps on the wall and marked the stations locations with pins.

World Radio History

(Continued from preceding page)

PARTS LIST

BP1 Antenna binding post.
BP2 Ground binding post.
BP3 "A" battery negative binding post.
BP4 "A" battery positive binding post.
BP5 "B" battery negative binding post.
BP6 "B" battery positive binding post.
L1-L2 Home-made radio frequency coil.
L3-L4-L5 Home-made three-coil coupler. T Tap on L4 is optional.
C1-C2 365 mmf. variable capacitors.
C3 .00025 fixed capacitor.
C4 .001 mfd. fixed capacitor.
R1 2 megohm fixed resistor.
R2 Filament rheostat for tubes.
V1-V2 Battery type triode vacuum tubes having low filament voltage. (Type 30, or equiv)
SW Battery switch.
TJ1-TJ2 Tip jacks for earphones.
C5 Small variable capacitor, about 20 pf. maximum.

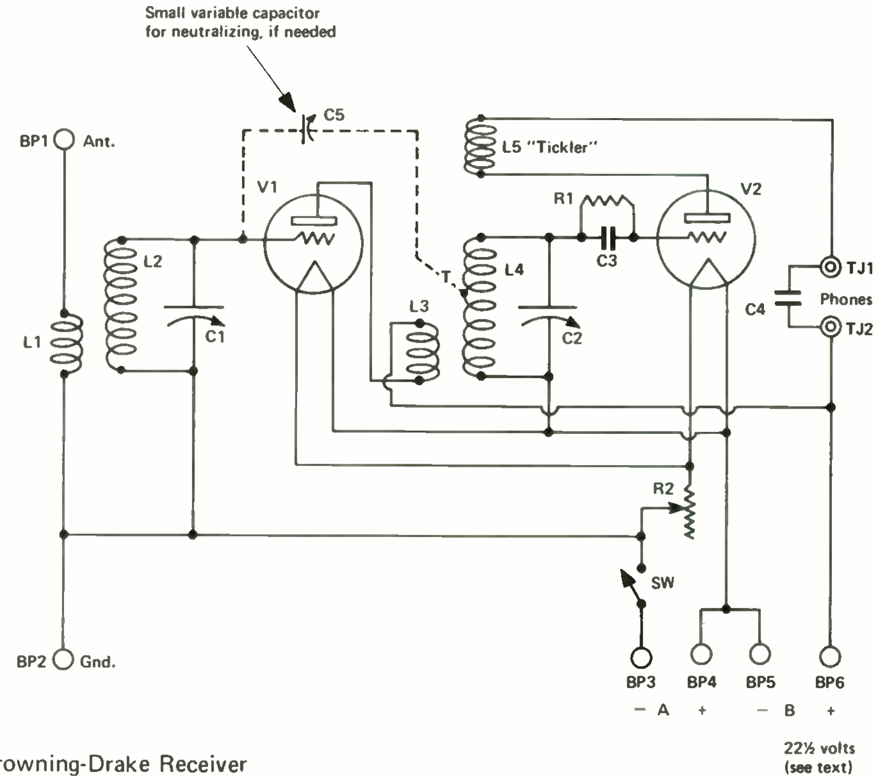


Fig. 1 Schematic for Browning-Drake Receiver

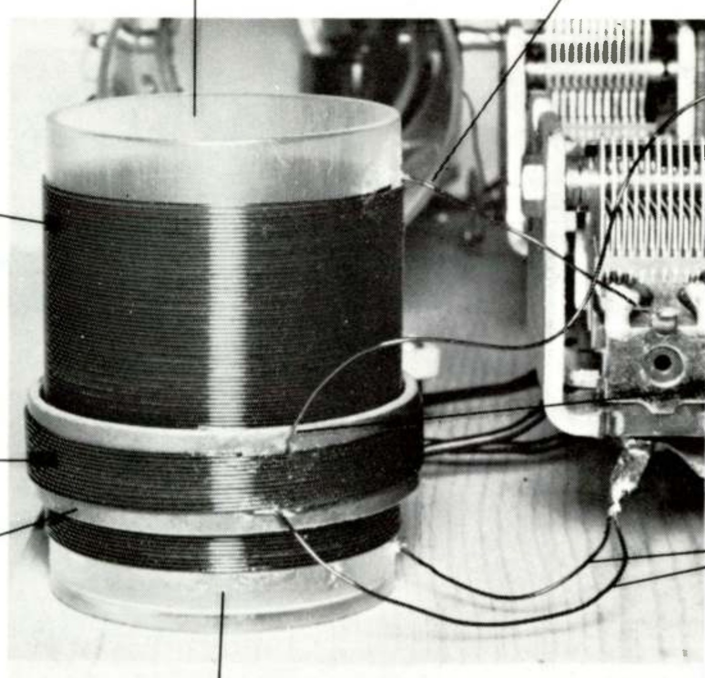


Fig. 2 RF coil (L1 L2) for Browning-Drake Receiver

World Radio History

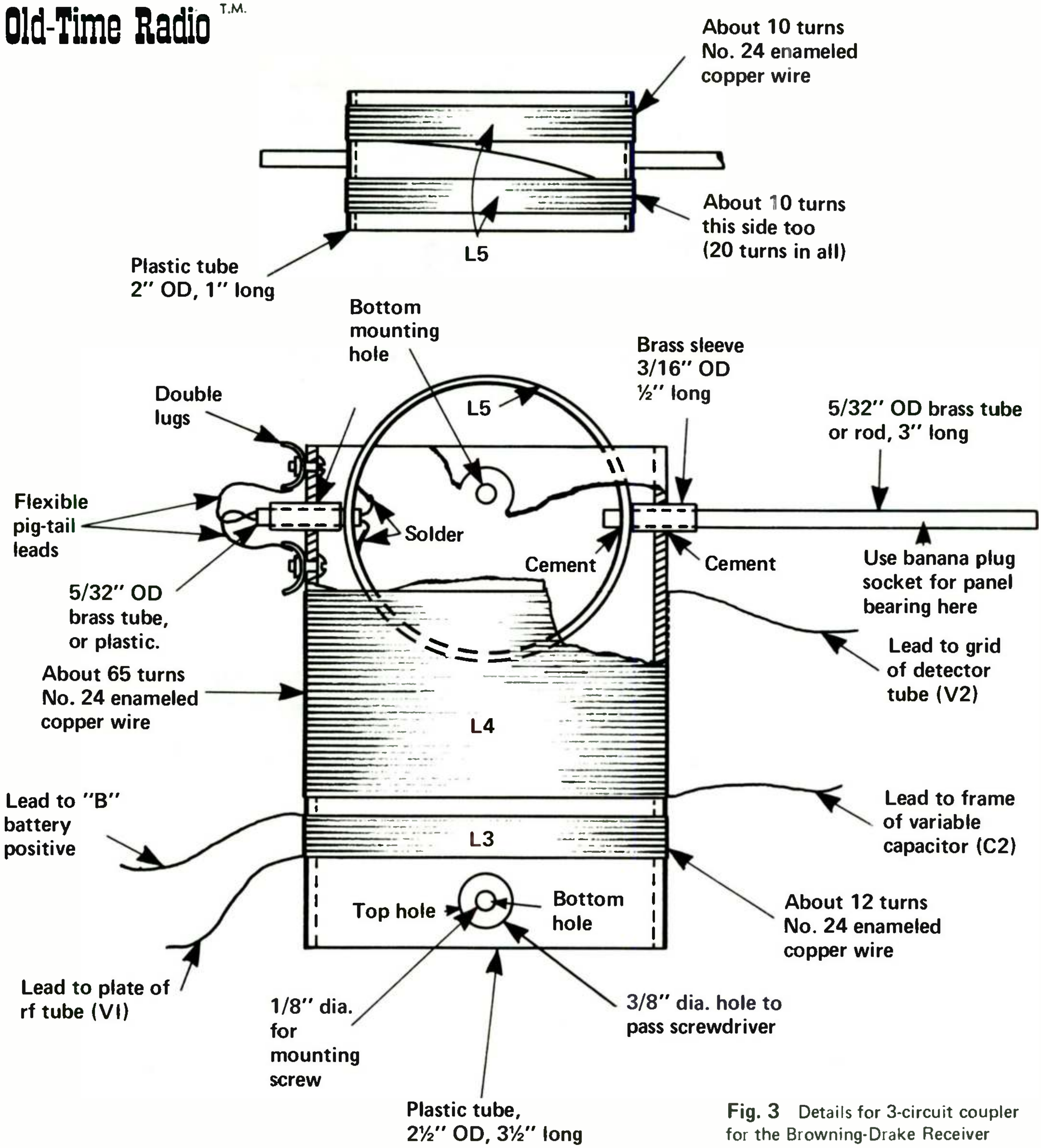


Fig. 3 Details for 3-circuit coupler for the Browning-Drake Receiver

BROWNING-DRAKE RECEIVER

(Continued from page 29)

the illustrations, little need be said in the text. Go ahead and use your own ingenuity, and experiment for best results, and perhaps you can improve on this project. That's the way to learn! While using modern parts on the inside of this set (with the exception of the two type 30 tubes) the writer attempted to make the outside of this set look like 1920!

Note in schematic diagram (Fig. 1) that a single 30-ohm rheostat is used to control the filaments of both type 30 tubes. You may find it an advantage to use a rheostat for each tube, so the writer allowed room on the panel for it. Also, you may want to run a separate "B" battery lead to L3 & plate of the trf tube (V1) so you can use up to 90 volts for higher amplification if desired, and in this case you will need to add another binding post.

Photo (Fig. 2) shows the construction of the trf coil (L1-L2). To make it handy for you a plastic pill container is used for the coil form. These measure about 1 13/16" OD, and are available at drug stores. Antenna coil (L1) is wound on a plastic ring that allows L1 to slide up or

(Continued on next page)

World Radio History

(Continued from page 31)

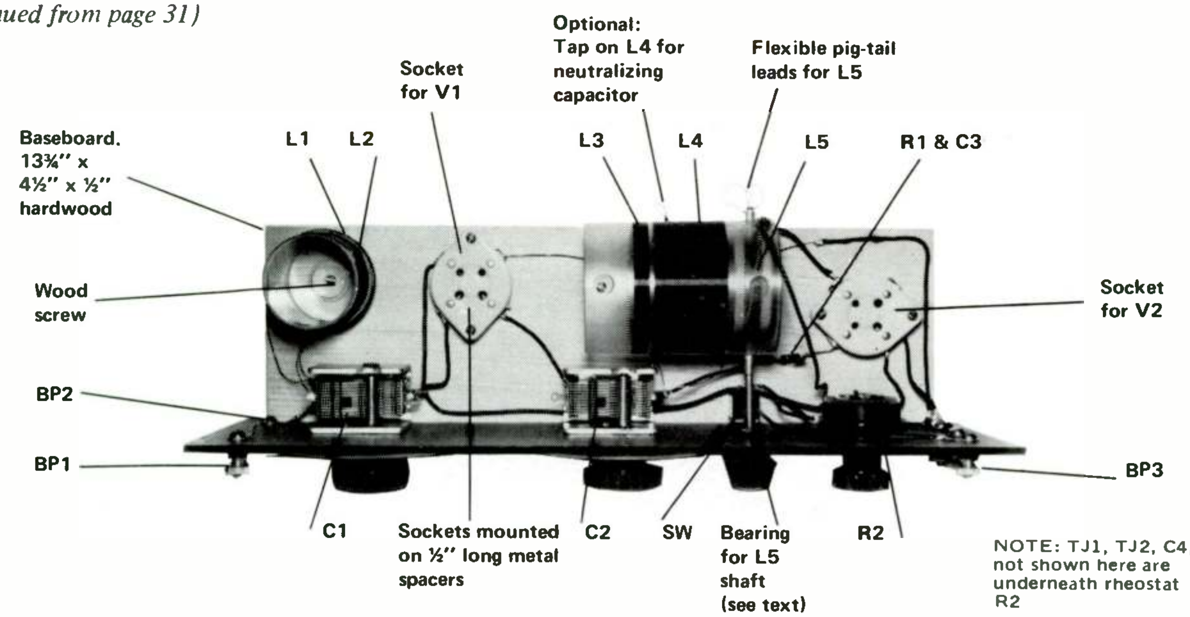


Fig. 4

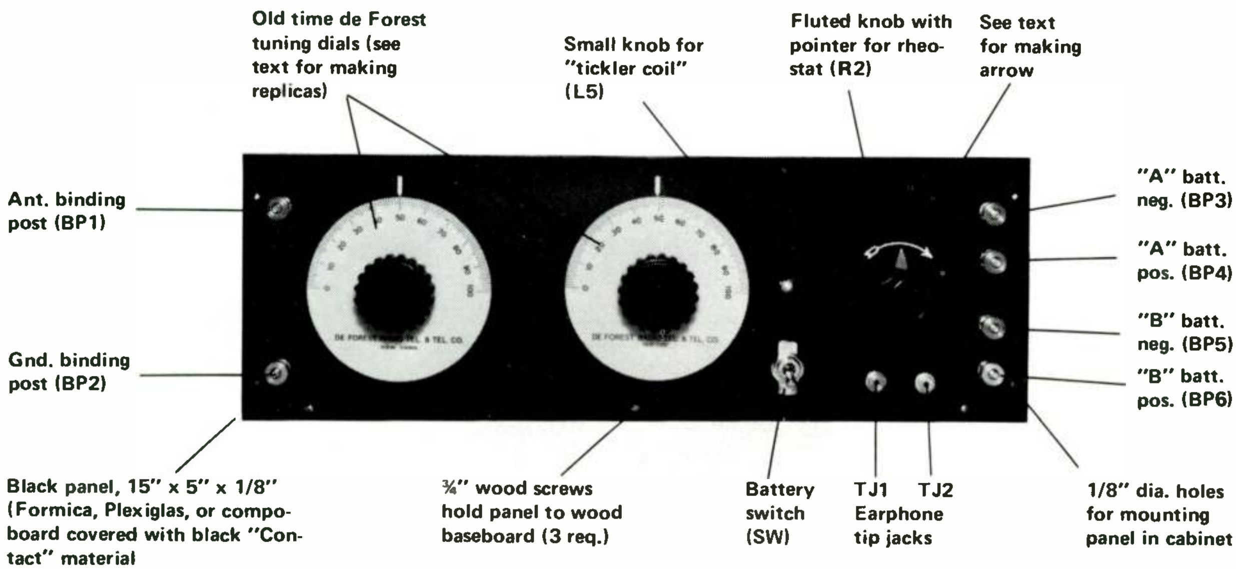


Fig. 5

Layout and Front Panel View of Browning-Drake Receiver

down over secondary coil (L2). Experiment for the right number of turns on L1 for your locality and your antenna and ground system.

Drawing (Fig. 3) gives details for the construction of the three-coil coupler (L3-L4-L5). Note that the wire leads of L5 are soldered to two flexible pig-tail leads passing through a metal sleeve to two soldering lugs, (if possible, use a plastic sleeve to prevent shorts if insulation wears off of the pig-tail leads). You can experiment for the best number of turns on primary coil (L3) and tickler coil (L5). For neutralization, twist a small loop in the wire when winding secondary coil (L4). This tap should be at about the 16th turn from the "ground end" of the coil. Again, you may have to experiment for the best place to put this tap.

Photos (Figs. 4 & 5) show the layout for the parts for this set. The coils and the tube sockets are screw-fastened onto the wood baseboard, the 3-coil coupler and the tube sockets use metal spacer tubes to hold them off the baseboard a ways. Use insulated flexible hook-up wire, and soldering lugs where needed, and make all leads as short and direct as possible. Note in photo (Fig. 4) that the shaft for rotating tickler coil (L5) uses a banana plug socket as a panel bearing for the shaft. If you use a compo-board panel covered with black "Contact" material, drill the holes in the panel before you put the Contact material over it. Since it is difficult to find old-time tuning dials these days, you can make two replicas of de Forest dials as shown in Fig. 7. To make the arrow for the rheostat pointer knob (see photo Fig. 5) use an ink compass and white paint, but practice first on a scrap piece of Contact

(Continued on page 34)

World Radio History

Old-Time Radio T.M.

(Continued from page 32)

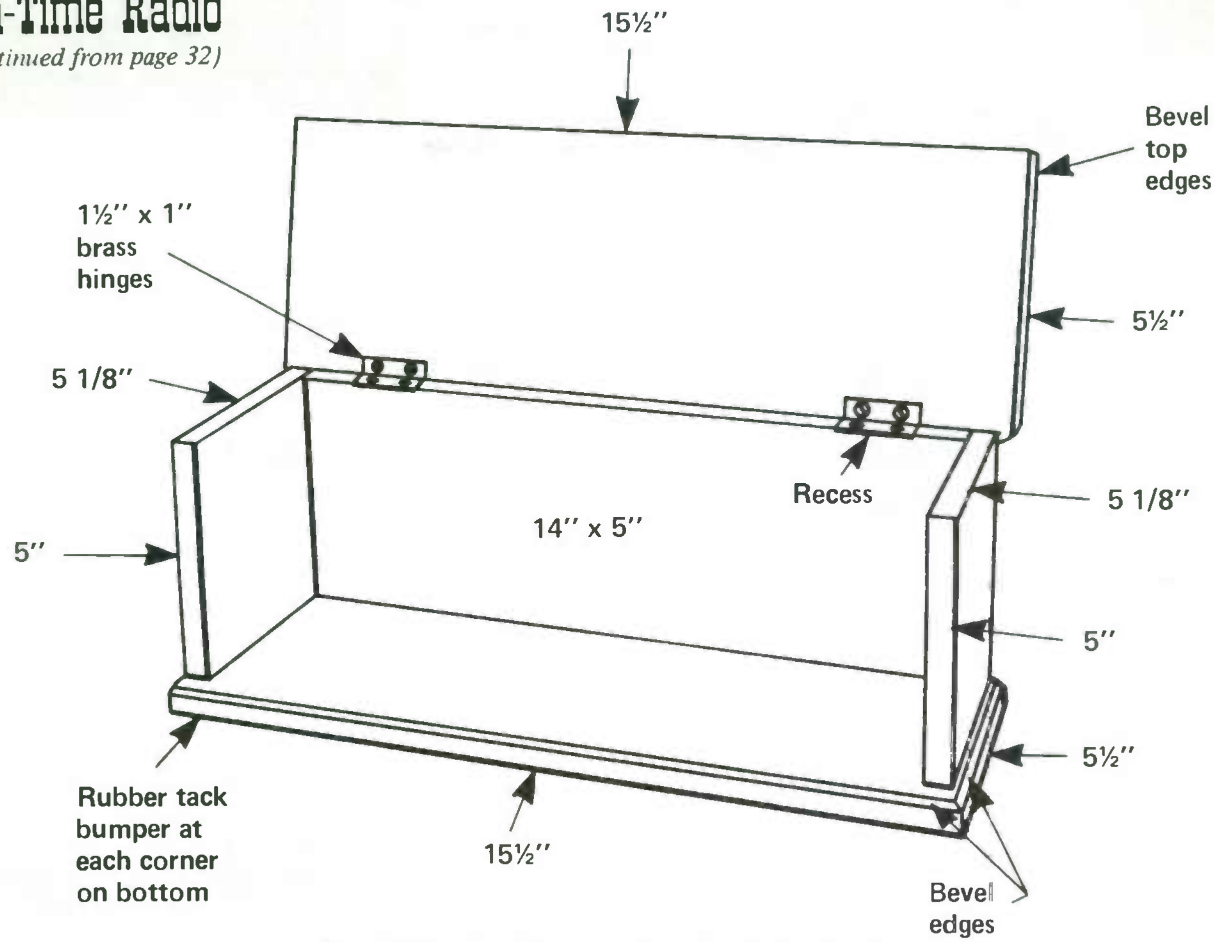


Fig. 6 Wood Cabinet for Browning-Drake Receiver

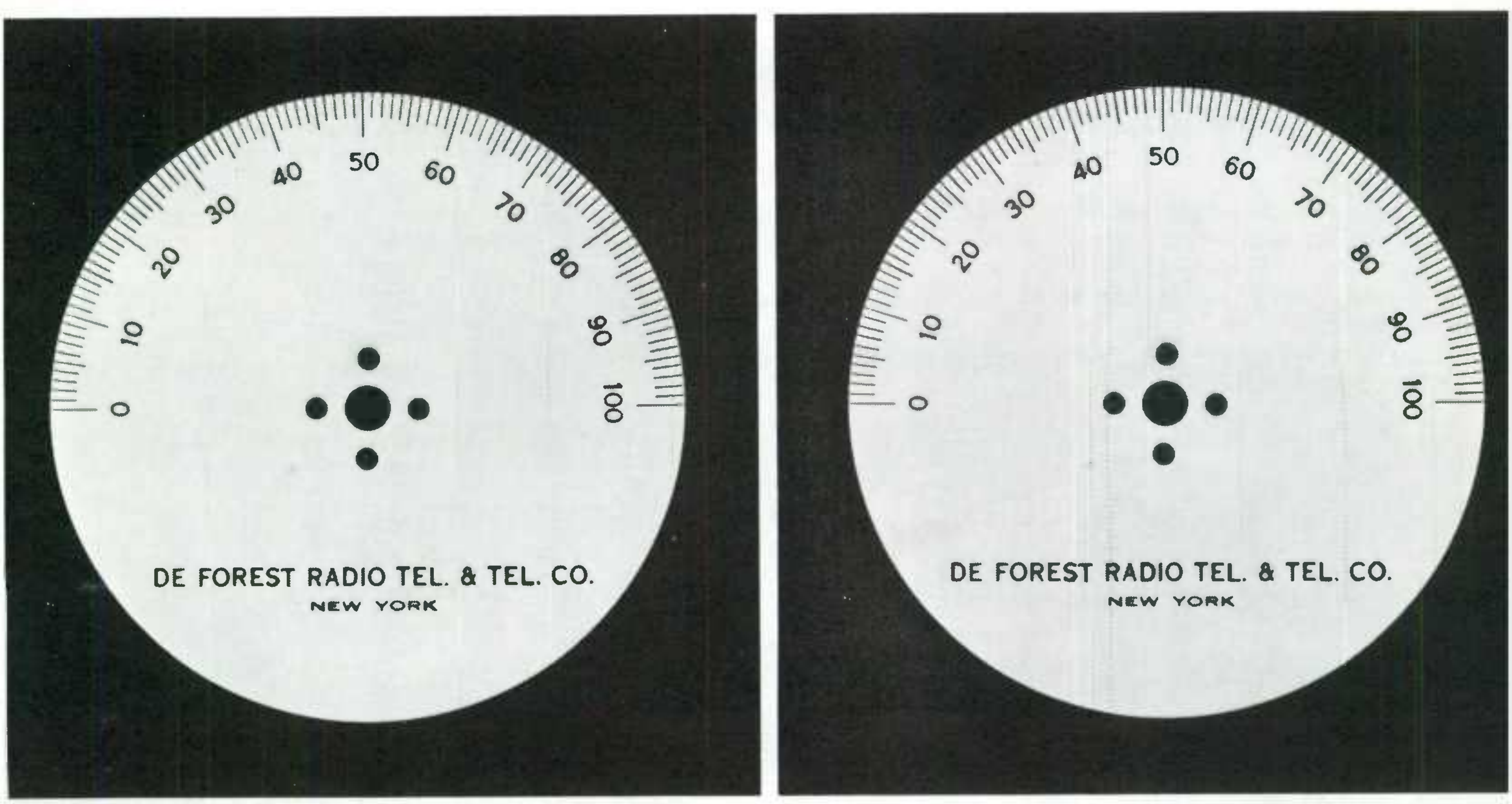


Fig. 7 These dial faces are actual size and may be cemented to dial plate.

World Radio History

BROWNING-DRAKE RECEIVER
(Continued from page 32)

material.

The neutralizing capacitor (C5) can be a small 3-plate variable capacitor of about 20 pfd., and mounted on the baseboard between coil (L4) and the grid terminal of the socket for the trf tube (V1). In operation, you adjust capacitor C5 for minimum oscillation in the trf stage. The writer didn't need C5 when using 22½ volts on V1.

The writer uses type 30 tubes having a filament voltage rated at 2.0 volts DC, and a filament current of only 0.060 ampere, but since these type 30's are getting scarce you may have to substitute with type 1H4-G's, or other similar tubes.

To make a 22½ volt "B" battery, see the January/February 1970 issue of ELECTRONICS DIGEST. You may want to make two of these "B" batteries and connect them in series to get 45 volts on the plate of the trf tube (V1) for more amplification.

Use a long outdoor antenna if possible, and a cold water pipe for the ground. Use a sensitive pair of high-impedence magnetic earphones. It is interesting to note that the writer uses a large metal bed and bed-spring as an antenna – this being nearly as effective as a 75 ft. outdoor antenna! You might also try using your phone as an antenna – simply clip the lead to the finger-stop on the dial.

If you want a cabinet for your receiver, see drawing (Fig. 6) for sizes and details. Use walnut, oak, or mahogany, for best appearance, and finish the wood to suit yourself. The writer put his cabinet together with wood screws and a good grade of wood glue.

To operate the Browning-Drake receiver, tune variable capacitors C1 and C2 for highest earphone volume on the desired station, while keeping the tickler coil (L5) just under the whistling point. Reverse connections to tickler coil (L5) if necessary for best oscillation.

MATERIALS LIST

Two 365 mmf. variable capacitors (C1-C2). (Allied Radio Shack 272-1344, or equiv.).

One .00025 mfd. ceramic disc capacitor (C-3). (Allied Radio Shack 272-124 comes close).

One .001 mfd. ceramic disc capacitor (C-4). (Allied Radio Shack 272-126).

One 2 megohm, ½ watt, fixed resistor (R1).

One 30 ohm wire-wound rheostat (R2). (Lafayette Radio 33R13368, or equiv.).

Two wafer type tube sockets to fit type of tubes used.

One SPST toggle switch (SW). (Allied Radio Shack 275-602).

Two phone tip jacks (TJ1-TJ2). (Lafayette Radio 32R64371).

Two old-time tuning dials for C1 & C2. (see text for making replicas).

One small knob for shaft of rotary "tickler" coil (L5).

One fluted black knob for rheostat (R2). (Lafayette Radio 32R24060).

Six old-time brass binding posts (BP1 to BP6). (Six 8-32 X ¾" round-head brass screws, with washers, hex nuts, and ornamental thumb nuts to fit).

Two low filament voltage, low filament drain, triode battery type vacuum tubes. (V1 & V2).

Panel. Black Plexiglas or Formica, 15" X 5" X ⅛", or compo-board covered with black "Contact" adhesive-back plastic material.

Baseboard. 13¾" X 4½" X ½" hardwood.

2 doz. soldering lugs.

Black insulated, stranded, hook-up wire. (Allied Radio Shack 278-1304).

Four ½" long metal spacers, and four round-head wood screws 1" long (for mounting wafer type tube sockets on wood baseboard).

Two ¾" long metal spacers, and two round-head wood screws 1¼" long (for mounting 3-coil coupler on wood baseboard).

Three round-head wood screws ¾" long (for holding panel to wood baseboard).

Materials for Coils:

One plastic pill container 1-13/16" OD, and 3" high (for L2).

One plastic ring 2" OD, and ½" wide (for L1).

One plastic tube 2½" OD, and 3½" long (for L3 & L4).

One plastic tube 2" OD, and 1" long (for rotary "tickler" coil L5).

One 6" length 5/32" OD brass tubing (for making shaft for rotary coil L5).

One 2" length 3/16" OD brass tubing (for making bearings for L5 shaft).

Two double soldering lugs, and two small round-head machine screws and nuts (for making terminals for rotary coil L5).

½ lb. #24 enameled solid copper magnet wire, for coils L1 to L5. (Lafayette Radio 32R30679).

Materials for Cabinet:

Two pieces hardwood 15½" X 5½" X ½" (for top and bottom).

Two pieces 5" X 5⅛" X ½" (for sides).

One piece 14" X 5" X ½" (back).

Two brass hinges 1½" long and 1" wide (for cabinet lid).

Flat-head wood screws, small nails, and glue (for putting cabinet together).

Four rubber feet for bottom of cabinet.

Four round-head wood screws ½" long (for fastening radio panel to cabinet).

EDITOR'S NOTE: Back copies of some issues of Electronics Digest are still available at 75 cents postpaid; and at $4.95 each, a few Annual Bound Volumes. The ABVs are attractively bound with a flexible cover ideal for student, teacher, or library use. A Three-Year Index of Electronics Digest, by issue, and alphabetically by subject, is available at $1.00 each postpaid. Project reprints are also available at 50 cents each postpaid.

All orders should be addressed to: Special Order Dept., Electronics Digest, P. O. Box 9108, Fort Worth, TX 76107. Payment by check or money order must accompany all orders.

PROTECT YOUR COPIES...

$3.50

U. S. and Possessions Only
(Other countries add $1.50)

This handsome binder of leather-like maroon vinyl will hold up to 12 issues of Electronics Digest. Great for home, school, or public library use! The ideal way to keep your magazines in one convenient location for ready reference. Order your custom binder, today!

Electronics Digest

1024 CURRIE STREET, FORT WORTH, TX 76107

Enclosed is $3.50 (check or money order) for which please send a custom binder to:

Name ____________________

Street ____________________

City ____________________

State ____________ Zip Code ____________

(Please Print)

World Radio History

RADIO SHACK ISSUES A NEW AND DIFFERENT CATALOG!

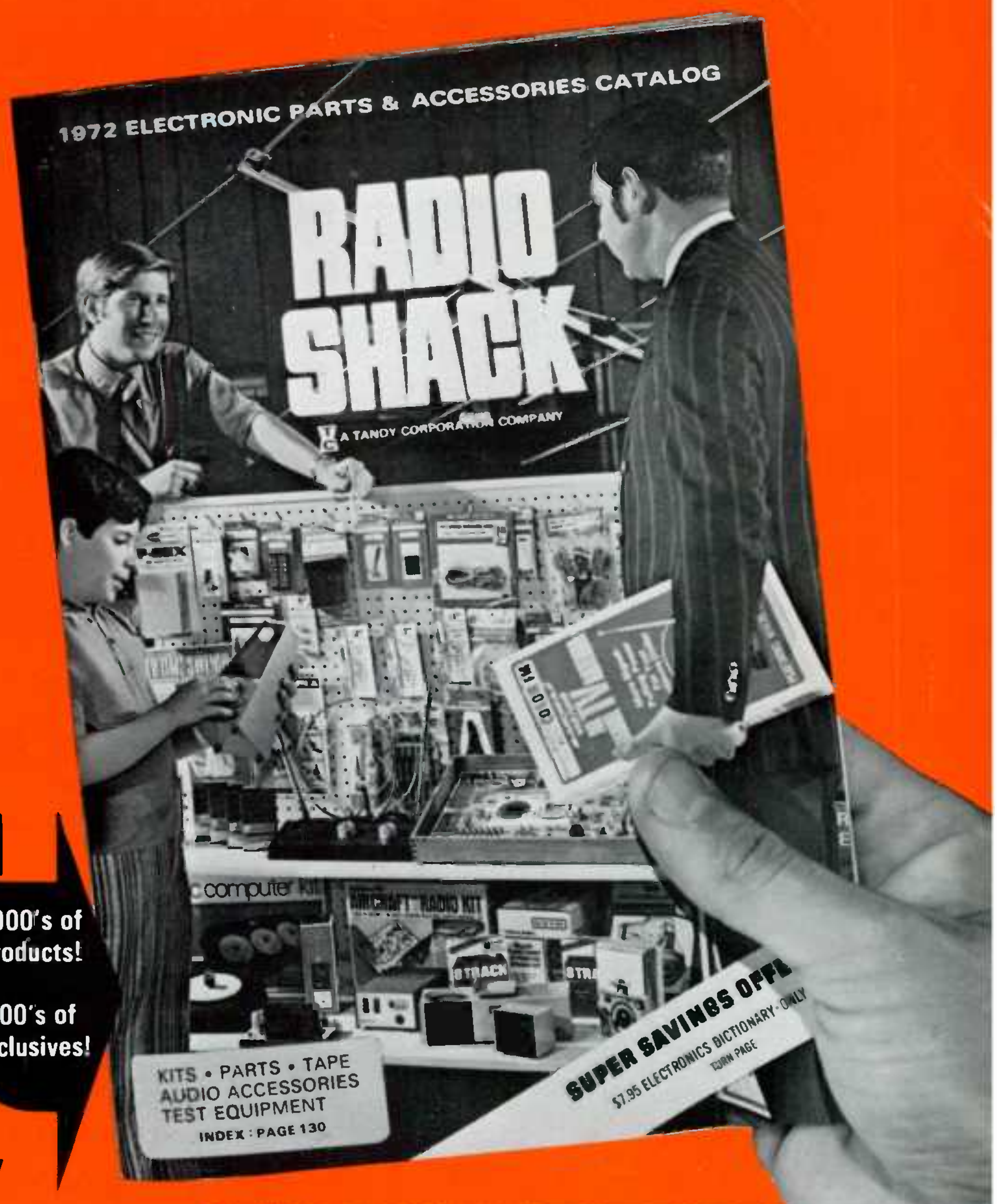
FREE
NEW 1972 EDITION

ELECTRONICS FROM A to Z

ANTENNAS • BATTERIES
CAPACITORS • DIODES
EDUCATIONAL KITS
FIBER OPTICS
GRILLE CLOTH
HI-FI SPEAKERS • IC'S
JACKS • KNOBS • L-PADS
MIKES • NEEDLES
OSCILLATORS • P-BOXES
QUADRACS • RESISTORS
SEMICONDUCTORS
TELEPHONES
ULTRASONIC ALARMS
VHF ANTENNAS • WIRE
XENON STROBE LIGHT
"Y" ADAPTERS
ZENER DIODES
AND MUCH MORE!

1000's of Products!

100's of Exclusives!



Get a Copy At Your Nearby Store or Mail Coupon Today!

THE buying guide for kit builders, Hams, CB'ers, installers, experimenters, fix-it men, hobbyists, electricians, anyone in electronics in any way. It lists 1000's of things most stores don't stock. Things that keep equipment working, or make it work even better or do even more. Features our complete Science Fair and Knight-Kit lines of electronics and hobby kits, too. Use this catalog to find what you need, then go to our store near you and get it. Or you may order by mail.

Over 1200 Stores in 49 States

RADIO SHACK Dept. ED-5
and
ALLIED RADIO STORES
TANDY CORPORATION COMPANIES
2725 W. 7th St. Fort Worth, Texas 76107

Send me your FREE 1972 Catalog #215
Please PRINT Clearly
Name____________________ Apt. #_____
Street or Rte. & Box____________________
City____________________
State________________ Zip_____

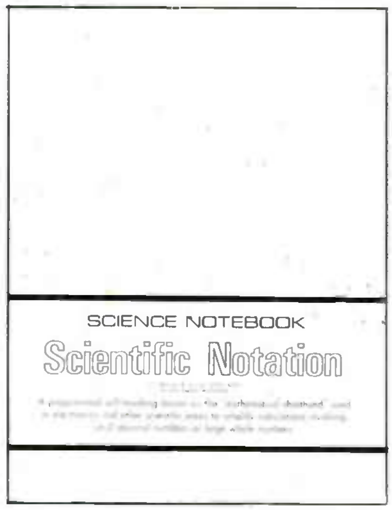
World Radio History

GIVE A GIFT . . . THAT GIVES ALL YEAR

ELECTRONICS DIGEST

A new kind of electronics magazine that is easily read by the entire family. An ideal science magazine for students and teachers alike. Regular features include history, biography, electronics and our environment, and basic electronic projects. Published bimonthly.

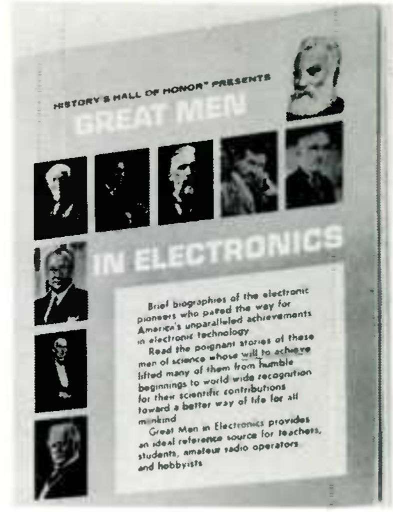
Cat. No. A-13 1-year subscription $2.50



SCIENTIFIC NOTATION

A programmed self-teaching lesson on the "mathematical shorthand" used in electronics and other scientific areas to simplify calculations involving small decimal numbers or large whole numbers. An excellent "short sourse" for students, hobbyists, or as a teaching review of the subject.

Cat. No. A-14 Each $1.00



GREAT MEN IN ELECTRONICS

Biographical sketches and photographs of sixteen outstanding inventors and business pioneers in electronics. It features under one cover a most unusual collection of old photographs of interest to students, teachers, hobbyists, and historians.

Cat. No. A-15 Paperback Edition, $2.00

HISTORY'S HALL OF HONOR

A special loose-leaf collection of brief biographies of great inventors and business leaders in electronics, illustrated throughout with historical photographs of electronic pioneers and the golden era of radio. Handsomely bound in a 8½ x 11 3-ring binder for convenient study by students, or classroom use by teachers.

Cat. No. A-16 in 3-Ring Binder $3.50

THREE-YEAR INDEX

Electronics Digest Three-Year Index features two sections — one indexed by issue of the magazine, the other by subject. It covers many, outstanding developments in electronics, history, biography, environmental electronics and basic electronics.

Cat. No. A-17 Three Year Index $1.00

ANNUAL BOUND VOLUMES

Electronics Digest annual bound volumes contain a wealth of electronic information not featured by any other electronic magazine on today's market. It's an ideal gift for student, teacher, or hobbyist; Available in volumes 1, 2, 3 and 4, attractively bound with flexible covers.

Cat. No. A-18 Volume $4.95

- ☐ A-13 $2.50 in U. S. and Possessions; Canada and Mexico. Other Countries $4.00
- ☐ A-14 $1.00 U. S. and Possessions; other countries Add 50 cents (U.S.)
- ☐ A-15 $2.00 U. S. and Possessions; other countries Add $1.50 (U.S.)
- ☐ A-16 $3.50 U. S. and Possessions; other countries Add $1.50 (U.S.)
- ☐ A-17 $1.00 U. S. and Possessions; other countries Add 50 cents (U.S.)
- ☐ A-18 $4.95 Each U. S. and Possessions; other countries Add $2.00 (U.S.) Please Check: ☐ Volume 1 ☐ Volume 2 ☐ Volume 3 ☐ Volume 4

Electronics Digest (published bimonthly)

Dept. 0055, 1024 Currie Street, Fort Worth, TX 76107

Gentlemen: Enclosed is a check / money order for $________
Please send items checked at left to:

Name ____________________

Address ____________________

City __________ State ______ Zip ______

Send Gift Card Signed ____________________

World Radio History