Build "Throbbing" Vibrato

- Tricks of Tape Splicing
- Eliminate Fluorescent Buzz
- Electronic Christmas Bells
- Update Your FM-3 Tuner

(see p. 41)
PORTABLE RECEIVER
for home and away—indoors and outdoors

NC-66

WORLD’S MOST VERSATILE RECEIVER! ... a ham receiver, a 3-way portable, a marine receiver, and an SWL receiver.

For home and away—indoors and out.

National’s new NC-66 offers you AC/DC-battery operation, five-band coverage from 150 kc to 23 mc, electrical bandspread with logging scale, plus a fixed-tuned CW oscillator. Housed in a handsome, rugged metal cabinet with a carrying handle, National quality is evident throughout this great new portable. You’ll find it attractively functional with a long “Full-Vue” slide rule dial, a quality 5” PM speaker, and a phone jack. It also has two antennas: whip and loop stick.

For boat owners a special marine band from 150 kc to 400 kc covers maritime DF beacon service. And, of course, CD positions are clearly marked.

FEATURES:

★ Continuous coverage of DF beacons, AM broadcast, amateur and world-wide shortwave bands. 150-400 kc., 5 to 23 mc.
★ Operates on 115 volt AC or DC or self-contained batteries, or 220 volt AC with accessory adaptor.
★ Full electrical bandspread.
★ Provisions for external direction finder for marine use.
★ Salt spray tested.
★ Built-in ferrite loop antenna for DF and BC bands.
★ Built-in whip antenna for shortwave bands.
★ Receives voice or code. Has CW oscillator; and provision for phones.
★ “Full-Vue” slide-rule dial with easy-to-read scale. Amateur and principal shortwave bands as well as CD positions clearly marked.
★ Logging scale provided.
★ Complete with built-in speaker.
★ Separate switch for stand-by operation.
★ Handsome, modern styling: two-tone metal cabinet, chrome trim, with carrying handle, and enclosed back.

*BAND

DF
BC
1
2
3

COVERAGE
150-400 KC
.50-1.4 MC
1.40-4.05 MC
4.0-11.4 MC
11.0-23 MC

TUNING SYSTEM: Separate general coverage and bandspread tuning capacitors connected in parallel on all bands. Three gang capacitors tune antenna, RF and oscillator circuits. Bandspread knob can be used as a vernier on all frequencies.

AUDIO SYSTEM: Two-stage audio amplifier with 3V4 output tube. Has speaker and phone output jack.

CONTROLS: Main tuning; bandspread; volume control; band selector switch; AM-CW switch; stand-by-off — receive switch.

TUBE COMPLEMENT:

RF
1U4
Converter
1L5
CW on-IF Amp.
1U4
2d Det.—AVC—1st audio
1U5

Audio output 3V4
Rectifier
Selenium

OTHER SPECIFICATIONS:

Antenna input: 50-300 ohms, unbalanced.
Size: 12-5/16” wide x 9-11/16” high x 10” deep (overall).
Finish: two-tone gray.
Shipping weight: 16 lbs. less batteries.
Optional accessories: RDF-66 Loop, 220V. adaptor.

Only $12.95* down
Up to 20 months to pay at most Receiver Distributors.
*Suggested Price: $129.95**
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Actual tune composed on GENIAC

COMPUTES, "REASONS"
PLAYS GAMES

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BUILD IT YOURSELF in a few hours!

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The Model 10 can be separated from the Model 310 as shown in the drawing at left by No. 311 lead attachment. This permits readings in difficult locations. No. 311 lence $1.90 net.

2nd news: Triplett Model 101 Line Separator
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Model 100 consists of Model 310 VOM, Model 10 Clamp-On Adapter, Model 101 Line Separator, No. 311 leads and carrying case with provision for all parts.

In addition, to use with the Model 310, the Model 10 Adapter also can be used as a Clamp-On Ammeter with any Volt-Ohm-Milliammeter having a 3 AC volt scale at 5000 Ohms per volt such as Triplett Models 630, 630-A, 630-NA, 631, etc., employing Triplott No. 611 leads, $1.90 net.

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CARL AND JERRY were standing with the manager of Carlton's Department Store watching Santa Claus talk to the children. Santa sat back in a curtained recess on a throne of artificial ice and snow, and the children came up to him one at a time to sit on his knee and tell him what they hoped to find under their trees on Christmas morning.

"Watch this one," said Mr. Bixby, the store manager, with a smile of anticipation as a pretty little dark-haired, hazel-eyed girl tiptoed cautiously toward Old Santa.

"Well, well," Santa boomed, scooping up the little girl and placing her firmly on his broad knee, "if it isn't little Carol! Aren't you the pretty one today! I've been thinking about you, and I know exactly what you want: a big new doll just like the one you saw out there in the window. Somehow I've got a feeling you're going to find that cuddly doll right in front of your tree Christmas morning... but, Carol, you must promise me something."

"Oh, I will, Santa, I will!" the wide-eyed little girl said fervently.

"Well, you mustn't hit your brother over the head with this doll and break it as you did your other one," Santa said with a twinkle in his blue eyes.

"I won't, Santa Claus; honest I won't," Carol promised as Santa set her back on her feet.

"And, Carol," Santa called as she was leaving, "you can tell your pretty mother for me that I'm glad she likes my voice."

Carol and a flustered, bewildered-looking mother made a quick exit from the store as Mr. Bixby turned chuckling to the boys.

THEY JUST can't figure it out," he said. "When you boys first suggested the idea to me, I never imagined it would work so well. And it is actually so simple.

With that hearing-aid earphone concealed by his whiskers, no one would ever suspect Santa was listening on a little transistorized receiver. By the way, that miniature transistorized wireless phone transmitter is camouflaged so well even I can't locate it. Just where is it?"

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CARL AND JERRY (Continued from page 8)

the point where each child waits his or her turn to talk to Santa," Carl explained. "As the parents coach their kids or chat with the other parents, the mike picks up wonderful clues for old St. Nick regarding Christmas wishes, past behavior, and so on."

"The word is spreading like wildfire," Mr. Bixby chortled, "that Carlton's Santa Claus is the only real one. He knows everything. In fact, boys, I'm so pleased that I'm going to give you a little bonus. Our agreement was that you were to receive fifty dollars for building and renting us the equipment. Well, here's thirty-five dollars for you, Jerry; and here's the same amount for you, Carl. I'm not even going to wait until we're through with the equipment. You boys may want to do a little shopping of your own with that money before Christmas Eve."

"Man," Carl exclaimed, after they had expressed their thanks and Mr. Bixby had left, "now we can buy that combination tube and transistor tester we've been wanting!"

Before Jerry could answer, Santa Claus rose from his throne and announced he had to go and feed his reindeer but would be back in half an hour. A curtain was drawn across his alcove, and he disappeared from sight. An instant later, though, Jerry saw him beckoning from the open door of a storage room.

"I was wondering if you boys could turn up the volume on that receiver a bit while I'm out to lunch," he suggested. "The store is getting noisier, and it's a little hard to catch what the children say at times. Just hoop it up a trifle, please."

CARL AND JERRY proceeded to the curtained-off alcove; and Jerry picked up the receiver, placed the earphone in his ear, and reached into his pocket for a screwdriver with which to adjust the volume. Suddenly he paused and started listening intently. Then he walked over and parted the curtain a little so that he could see the spot where the hidden transmitter was located. Carl, looking over Jerry's shoulder, saw a little boy of four or five leaning back against the railing while another boy of ten or eleven, obviously a brother, knelt in front of him talking earnestly. Jerry removed the earphone from his ear and turned up the volume of the receiver so that Carl could hear the conversation between the two boys out in the store.

"But, Timmy," the older was saying, "we

(Continued on page 14)
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Carl & Jerry (Continued from page 10)

ought not wait for Santa to come back. The folks will be worried about us. Anyway, I don't think you should ask Santa Claus to bring you that electric train. You don't understand, but seventy-five dollars is an awful lot of money. What with Dad being sick for so long and everything, maybe we shouldn't expect too much for Christmas this year."

"Why, Ronnie?" the little tow-headed youngster asked. "You think Santa only brings presents that cost a lot to little boys with rich parents? If that's so, what's the use of being Santa? That's not the way it is. Santa Claus can do anything. When I tell him I want the train so Daddy and I can play with it together and Daddy will forget how bad he feels, I just know I'll get it. When Daddy was a little boy, he wanted an electric train more than anything, but he never got one. Don't you see that I've just got to stay and explain this to Santa?"

Little Timmy stood up straight, and for the first time the boys saw the crutches under his arms and caught the glint of metal braces on his slender legs.

Carl smiled wryly as he answered the question in Jerry's eyes. "Bye-bye tube and transistor tester," he chanted softly.

"I knew you'd be soft-hearted and soft-
CARL E. SMITH, E. E.
President

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<table>
<thead>
<tr>
<th>Name and Address</th>
<th>License</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>John H. Johnson, Boise City, Oklahoma</td>
<td>1st</td>
<td>20 weeks</td>
</tr>
<tr>
<td>Prentice Harrison, Lewes, Delaware</td>
<td>1st</td>
<td>27 weeks</td>
</tr>
<tr>
<td>W. E. Evey, Ottawa, Kansas</td>
<td>2nd</td>
<td>24 weeks</td>
</tr>
<tr>
<td>Raymond L. Gersig, Pittsburgh, Pa.</td>
<td>2nd</td>
<td>24 weeks</td>
</tr>
<tr>
<td>Francis W. Bartley, Danbury, Conn.</td>
<td>2nd</td>
<td>15 weeks</td>
</tr>
</tbody>
</table>

(Names and addresses of trainees in your area sent on request)

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Name __________________________ Age ______

Address _________________________

City __________________ Zone ______ State __________

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Carl & Jerry (Continued from page 14)

headed enough to say that," Jerry exclaimed, digging an affectionate elbow into the ribs of his lanky friend. "Let's go hunt up Mr. Bixby and buy that train right away. Then we must brief Santa a little. Finally we'll follow the kids home and see where they live. It must be close because the little fellow couldn't walk too far."

THE BOYS found Mr. Bixby talking with Santa Claus, who was delicately plying a toothpick through his whiskers in a most mortal manner. Constantly interrupting each other, the boys explained to the store manager what they wanted to do.

Now Mr. Bixby had not become the head of Carlton's Department Store by being a sentimentalist, but even he was not immune to the Christmas spirit, and there was something about the impetuous way the two boys responded to the appeal of little Timmy that touched him.

"I've an idea, boys," he said. "The store and its employees build up a fund every Christmas to help needy cases. How would it be if you two kept the money that you've earned and let us take care of this for you?"

Carl and Jerry exchanged glances, and then Carl spoke up for both of the boys:

"We appreciate the offer, Mr. Bixby, but if you don't mind we'd like to do it ourselves. You see, up to now Jerry and I have almost always been on the receiving end of things. Everyone has done things for us. I guess it's about time we started trying to do a little something for others. It makes us feel sort of grown-up and good inside."

"Okay, okay!" Mr. Bixby said hurriedly, clearing his throat; "but you mustn't be selfish about this. Let us help a little, too. The store will sell you the train at our cost price, and that'll leave enough over to buy a nice present for Ronnie."

The boys quickly agreed to this proposal, and Santa took his place on the throne. The curtain was pulled back, and Timmy started toward him at once, swinging through his crutches.

"AS I LIVE AND BREATHE and harness my reindeers, if it isn't my little friend, Timmy!" old Santa exclaimed, carefully gathering up the little boy. "I've been watching for you because I know just what you want."

"Really, Santa?" the little curly-headed blond boy asked, his blue eyes open wide. "Unless my elves have been telling me...

The stiffness of the compliance is balanced to the mechanical resistance and inertia of the peripheral cone section so that the mass of this outer section effectively prevents the transmission of sounds above 1,000 cycles beyond the mid-compliance and the cone uncouples at this point permitting the inner section to operate independently for the reproduction of tones above 1,000 cycles. Proper phasing between the two sections is assured by the controlled mechanical resistance provided by the viscous damping applied to the mid-compliance.

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GREAT ADVANCE IN SHOP-METHOD HOME TRAINING

December, 1957
Carl & Jerry (Continued from page 16)

wrong, it’s an electric train; and I can just see you and your daddy playing with it under the tree on Christmas morning,” Santa said dreamily, with his eyes closed.

“You hear that, Ronnie; you hear that?” Timmy shouted, bouncing up and down on Santa’s lap in excitement.

“And,” Santa continued, “I wonder how Ronnie would like a fine transistor radio kit that he and his daddy could put together?”

The boys could see Ronnie nodding his head up and down so vigorously that his sock cap slid down over his eyes. For the moment, all the sophisticated cynicism of late childhood had deserted him.

Timmy was so excited he could not sit still; so Santa carefully set him on his feet and watched him and Ronnie making their way down the aisle. If you watched very, very closely, you could have caught a secret sign of mutual approval, made by circled thumb and forefinger, being exchanged by Mr. Bixby in the balcony, Santa Claus, and two boys who casually followed Ronnie and Timmy through the crowded store.

One of the boys was short and plump and dark, the other with glasses was tall and blond and athletic; but on the face of each was exactly the same happy, contented, “Christmassy” smile.

---

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- [ ] Aeronautical Electronic Engineering Technology
- [ ] Television Engineering Technology

Name

Street

City

Age

Zone...State

Check: [ ] Home Study  [ ] Residence School  [ ] Korean Veteran

---

December, 1957
Letters

Out of Luck

- Can you give me addresses of companies that want wireless operators? I'd like to join the U. S. Merchant Marine as a wireless operator. I am 18 years old, a Dutchman, and hold a second class ticket.

R. van den Berg
Singapore, Malaya

In order to work on an American ship, you would require a Federal Communications Commission ticket. Only U. S. citizens—with very rare exceptions—can get such a ticket. That goes for airlines, too.

- Is it possible to make a transistor metal locator cheaply?

Philip Shaw, Jr.
Redondo Beach, Calif.

Not only would it be more expensive to do so but you would probably sacrifice sensitivity as well because of oscillator power requirements.

Can We Help?

- In a recent issue you described some of the possible uses of an electronic paging system. You also mentioned a company called "Page Boy, Inc." This kind of a system seems to have possibilities in the Naval shipyard in which I am now serving, and I would be very grateful if you could give me the names and addresses of some of the companies that make the equipment.

Peter Cossette
Cmdr. R.C.N.
Victoria, B. C.

Two of the manufacturers of this equipment are:

Page Boy, Inc. Stromberg-Carlson
1724 E. 12th St. 1710 University Ave.
Brooklyn, N. Y. Rochester, N. Y.

- On page 92 of the October issue you mention a "Bambinophon." Who sells it?

G. Jentzen
Washington 10, D.C.

- I saw your article about the "Bambinophon" and was wondering if it was for sale in this country.

Verne Armstrong
Raymond, Minn.

- Saw the story on the transistor tape recorder for the small fry. Where can I get it?

Michael Axelrod
Uniontown, Pa.

As far as we know, the "Bambinophon" recorder is available only from:

Dr. Windhaus & Co.
35 Graf Adolph Str.
Dusseldorf, Germany

- In the August issue you describe a Metz portable

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☐ COLOR TV ☐ AIR TRAFFIC CONTROL ☐ COMMERCIAL AVIATION
☐ ELECTRONICS ☐ NAVIGATION ☐ U.S. CIVIL SERVICE
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☐ ATOMIC ENERGY ☐ OTHER ☐ YOUR OWN BUSINESS

CHECK ONE: ☐ RESIDENT TRAINING ☐ HOME STUDY

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City, State __________________________ County ______________

C. L. FOSTER
President

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December, 1957 21
Centralab Ceramic Transmitting Capacitors

4 Ways Better

- 60 to 90% smaller
- 50 to 75% less expensive
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You don't have to take our word for it. Here's what a satisfied user has to say — “We have found that Centralab capacitors are a 'must' in high-power r-f work. They are the only ones whose internal inductance is low enough to do the job.”

They're ideal for stationary and mobile transmitters, tuned tank circuits, antenna circuits, and other applications where high-voltage, high-frequency circuits are required.

CRL capacitors have extremely low pf (down to .1%) and inductance. Their “double cup” design provides greater strength and long leakage paths—prevents arcing.

You can choose from 39 types...11 terminal styles. Capacitance, 3 to 1000 mmf, 5 kv to 20 kv d.c. Low moisture absorption meets applicable MIL specifications.

Get your CRL Series 850 ceramic transmitting capacitors from your Centralab distributor. They're shown on page 39 of Catalog 30. If you don't have a copy, ask your distributor for one, or write direct to Centralab.

Letters

(Continued from page 20)

radio. Where would I be able to get one of these?

LEIGH ERLAU

Atlanta 9, Ga.

The manufacturer is:

Metz Apparatefabrik

Fuerth/Bayern, Germany

While glancing through your July 1956 issue, I noticed an article called “Closed-Circuit Television—New Communications Tool.” In it you mention a system called “Visicall.” Could I have the name and the address of the manufacturer?

H. D. LESHER

Vegas Video Sales Service

Las Vegas, Nev.

The manufacturer is:

Sperti Faraday, Inc.

Adrian, Mich.

Dep't. of Conflagration?

The photo shows a “horn” built into my fireplace. When I don’t use the fireplace for heat, I use it for hi-fi. Santa can use the door.

I find it gives amazing results, costs very little, and you can even use the fireplace screen for grille cloth. Please note that the flue should be plugged with newspapers. But be sure to unplug it when you light it up—the fireplace, that is.

HOWARD L. WILBUR

San Diego, Calif.

Sounds like a spark-ling good idea.

Pats On the Back

In the September issue I read and enjoyed the article “Radio Keeps You in Touch.” I took special interest in the section on mobile radios. I would like to have one of these units in my car but have one question: how would you go about getting service if you were to leave the vicinity where you originally had the equipment installed?

J. F. RICHMOND

Joppa, Maryland

If you are talking about phone company installations, you would have to get a new installation from your phone company if you move out of a particular area.

Could you please transmit to me all relevant in-

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Letters

(Continued from page 22)

formation on the well-modulated girl on the June cover of Popular Electronics. It is impedance that I know so that I will be able to reactance. All details received will be kept in strictest fidelity by yours truly.

Andrew Nagy
Hamilton, Ontario

All data on this device represents a well-modulated trade secret.

The Women Again

In the August magazine, Dave Kavanaugh wanted to know if women did not read POPtronics. I don't know about "the women," but I read every issue from "kiver to kiver." I'm also a charter member and have every issue that has been published. I only wish you would publish it more often and put more in to help hams pass their exams for the various licenses.

Ruby H. Liverly
K0GKV
St. Louis, Mo.

In answer to reader Dave Kavanaugh's letter, women do read P.E.; at least this one does. I like your column for the Novice Hams.

Carolyn Thompson
Marblehead, Mass.

I will join Margaret Le Fevre (October issue) as another of your estimated 3-4% feminine readers. My husband and I first heard of POPtronics a year ago and subscribed immediately. I first read Carl & Jerry, Short-Wave Report, and Among the Novice Hams; then any other articles I can understand. Herb Brier's current series of lessons is exactly what I need as I have had difficulty finding textbooks simple enough for a beginner to understand.

Ruth S. Congram, KN9JCN
Monticello, Ind.

The girls are swamping us. Any more questions about women!

Back Issues

I am trying to locate a copy of the May 1955 issue. It is not available from your Circulation Department and I have been wondering whether any of your readers could supply me with this issue. I am willing to pay any reasonable price, including postage.

Charles Dunlop
1902 Sheridan Road
Evans ton, Ill.

These are the issues that are currently out of circulation:

<table>
<thead>
<tr>
<th>Month</th>
<th>Issue</th>
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<tbody>
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<td>May 1955</td>
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<tr>
<td>June 1955</td>
<td></td>
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<tr>
<td>February 1956</td>
<td></td>
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</tbody>
</table>

Some More Assists

I have just read "Radio Keeps You In Touch" in the September issue and enjoyed it very much. For some time our office has been interested in obtaining a communication system for use between

New Transcription-Type Tone Arm Makes Collaro World's First True High Fidelity Changer

From Collaro Ltd., world's largest manufacturer of record playing equipment — comes the most significant development in years — the exclusive new transcription-type tone arm, which transforms the conventional record changer into a TRANSCRIPTION CHANGER, with features of the finest professional equipment.

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In its superb performance, the new Collaro Continental, Model TC-540, meets the rigid requirements for high fidelity equipment, offering professional quality at a record changer price. The Continental is $46.50. Other Collaro changers are priced from $37.50 up. (Prices slightly higher west of Mississippi.)

Collaro CONTINENTAL, TC-540
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MAMARONECK, N. Y.

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One exactly suited to your needs. My easier-than-ever payment terms make it possible for you to get set for the good jobs in Radio-Television without the slightest strain on your budget! Get the true facts...just mail the coupon for my big new 56 page fact-filled catalog plus actual sample lesson—both FREE.

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The coupon below brings you my big new catalog plus an actual sample Sprayberry Lesson. I invite you to read the facts...to see that I actually illustrate every item in my training. With the facts in your hands, you will be able to decide. No salesman will call on you. The coupon places you under no obligation. Mail it now, today, and get ready for your place in Radio-Television.

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December, 1957
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TRAINING AID KITS

• THIS NEW PROGRAM designed by MacFarlane Industries will enable the novice or advanced student in electronics to develop the highest levels of capability in the applications of practical electronics. Although MacFarlane Industries courses are not intended as a substitute for university, college, or vocational training, the courses and kits provided can be a useful influence in an individual's career in electronics. This particular program is the key to a far more complete and satisfying education than mere formal educational institutions.

The philosophy governing this program is based on the ability of students to arouse and stimulate their interest to the point that the usual drudgery, difficulty and consequent boredom which often attend training efforts are eliminated. Results indicate that a dynamic, alert and vitally creative individual emerges.

METHODS OF TRAINING

All text materials, experiment kits, etc. are produced on automatic electronically controlled equipment. Problem games and examinations are all electronically evaluated. In order that each individual gets full opportunity to examine and develop skill in the operation of specialized instruments, an electronic computer schedules shipment of kits and instruments to correlate with the study pace of each individual, thus even though groups begin their effort simultaneously there is no requirement to either rush your studies or to be delayed by others.

SEND TODAY FOR
INFORMATION ON TRAINING AID KITS

MACFARLANE INDUSTRIES EDUCATIONAL DIVISION
P.O. Box 33 • Redondo Beach, California
Please send me free, complete information on Training Aid Kits.

NAME __________________________ AGE __________
ADDRESS __________________________
CITY _______ STATE _______

Letters

(Continued from page 24)

offer and automobiles. If possible I would like to obtain the addresses of companies that manufacture equipment of this type. Class A Citizens' Band radios sound promising and should be adequate.

L. A. PARKS, JR.
Parks Realty Co.
Statesville, N. C.

Manufacturers of this type of equipment are:
Motorola
1501 W. Augusta Blvd.
Chicago 51, Ill.
General Electric
Radio Corporation of America
Camden, N. J.

- You list radios for the Citizens' Band. Could you tell me who sells them?

HAROLD B. COMER
Elkton, Va.

For Class B:
Vacoline
Conner St.
Old Saybrook, Conn.
and perhaps:
Citron, Inc.
Cleveland 3, Ohio

More on the "VHF Ear"

- I built the "VHF Ear" (July '57). It works quite well with the 16" piece of stiff copper wire but I was wondering if a longer antenna would bring in a better signal?

DAVID GETCHELL
Rockville, Conn.

No, it would not. The 16" wire is resonant. You would lose sensitivity with a larger antenna.

- I took a vacation in Texas this year and flew via American Airlines. I really had fun with the "VHF Ear" except when my wife was nagging me: "Let me hear" . . . "I want to listen" . . . The reception was perfect. We landed in El Paso and had a four-hour layover. It really went fast because we were listening on the "Ear."

ROBERT G. ERICSON
San Diego, Calif.

The "Ear" is one of our most popular projects. Everyone seems to be building it. —50—

Out of Tune

Meter Your Enlarger Exposures (October, 1957, page 77): Referring to the schematic and pictorial on page 78, the lead from switch S2 should be connected to pin #1 of the OA2 tube, not to pin #5. This change is necessary to "isolate" PC1 during the first step of the calibration procedure. Pins #1 and #5 are joined internally in the OA2 tube by a jumper, so that removing tube opens circuit. —50—

Always say you saw it in—POPULAR ELECTRONICS
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**AT A PRICE YOU CAN AFFORD!**

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Think of it — a complete training program including over 120 lessons, Eleven Big Radio-Television Kits, Complete Color-TV Instruction, Unlimited Consultation Service... ALL AT a really big saving to you. How can we do this? Write to us today... and find out!

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We Went 100 More Shops for 1957

This 35 year old training organization called RTS, that's Radio-Television Training School — a string of Radio-TV Repair Shops in principal cities throughout the U. S. So far, 36 such shops are NOW IN BUSINESS AND PROSPERING. We are signing contracts with ambitious men to become future owners and operators of these shops in all areas.

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find out how you can open
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We supply and finance your equipment

When you are ready and qualified to operate one of our RTS-Approved TV Repair Shops WE WILL SUPPLY AND FINANCE EVERY BIT OF EQUIPMENT YOU NEED TO GET STARTED plus an inventory of parts and supplies. In other words we will stake you AN OFFER NEVER MADE BEFORE BY ANY TRAINING ORGANIZATION. Under the RTS Business Plan you receive:

1. An electric sign for the shop front.
2. Complete laboratory of test equipment.
3. Letterheads, calling cards, repair tickets, etc.
4. Basic inventory of tubes, parts, supplies.
5. Complete advertising and promotional material.
6. Plans for shop arrangement.
7. Instructions on how to go into business.
8. Continuous consultation and help.
9. The right to use RTS Seal of Approval, and the RTS Credo.
10. The right to use the Famous Trade Mark.

So sign up be trained in Radio-TV Repair, Merchandising and Sales by our training methods — because WE KNOW the requirements of the industry. Therefore, we will TRAIN YOU... we will show you how to earn EXTRA CASH, during the first month or two of your training period. YOU KEEP YOUR PRESENT JOB. TRAINING TAKES PLACE IN YOUR OWN HOME, IN YOUR SPARE TIME!

---

SEND ME FREE — all of these big opportunity books — "Good Jobs in TV-Electronics," "A Repair Shop of Your Own," and "Sample Lesson." I am interested in:

- Radio-Television
- Industrial Electronics (Automation)

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Address ______________________________________

City & State ____________________________

December, 1957
Five of the country's largest electronic parts supply houses this month announced the publication of their 1958 catalogs. Free for the asking, several of these catalogs feature special components and kits unavailable elsewhere.

**Allied Radio** (100 N. Western Ave., Chicago 80, Ill.) has a complete line of kits designed for the do-it-yourself enthusiast, including test equipment and hi-fi gear. The Knight label, which is Allied's own, has been appearing on well-constructed kits for many years and the new line continues the tradition of high quality at low cost.

**Burstein-Applebee** (1012-14 McGee St., Kansas City 6, Mo.) presents a fine selection of standard tools and household appliances at discount prices in their catalog, in addition to standard electronic components. The bargain hunter will do well to look over B-A's "special purchase" items starting on page 132.

**Lafayette Radio** (165-08 Liberty Ave., Jamaica 33, N. Y.) features many exclusive imports in the electronic and photographic area. In addition, there are Lafayette's own high-fidelity components, available in both kit and factory-wired form. And of course, there's a special section devoted to transistor kits and components for the POP'tronics readers with that particular passion.

**Newark** (223 W. Madison St., Chicago 6, Ill. and 4736 W. Century Blvd., Inglewood, Calif.) stands ready to serve our West Coast readers with a full line of components for the hobbyist and industrial user. A number of specialty manufacturers and products are listed.

**Radio Shack** (167 Washington St., Boston 8, Mass.), has a well organized catalog featuring industrial, servicing and high fidelity components. Radio Shack's own line of hi-fi is featured under the "Realistic" label. Check their little 10-watt amplifier and speaker as an ultra-economical system for the newcomer to audio.

All in all, our distributors are doing a fine job in presenting not only the standard brand electronic merchandise but many special items worth serious consideration by the wise shopper.

---

**The price will be music to your ears, too!**

40-14,000 cycles—elliptical cone tweeter—complete dividing network. And the price...$19.50. That's right, $19.50. Yet it outperforms speakers selling at three times the price. Interested? Listen to the CA-12 and be convinced.

NEW SONOTONE CA-12 12" CO-AXIAL LOUDSPEAKER

Ask your dealer for a demonstration, or send your name and address for full details.

Electronic Applications Division

SONOTONE® CORPORATION

Dept. LG-127, ELMSFORD, N. Y.

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Always say you saw it in—POPULAR ELECTRONICS
The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction procedure, trouble-shooting, and servicing.

You will learn how to build radios, using regular schematics; how to wire and solder in punched metal chassis; how to install a 240 volt special power supply; how to install the latest development of Printed Circuit chassis; the tuning and trouble-shooting methods.

You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progress- sive Electronic Radio & Electronics Tester & the accompanying instructional material.

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build 16 Receiver, Transmitter, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for Televison. The Signal Injector is the perfect tool for any home service.

Absolutely no previous knowledge of radio or science is required to build the "Edu-Kit." The "Edu-Kit" will provide you with a basic understanding of electronics which, in many times, the complete price of $229.50. The Signal Tracer alone is worth more than the price of the entire Kit.

The Kit for Everyone

You do not need the slightest background in engineering or science. Whether you are interested in radio as a hobby or want to learn about it for a vocational or job with a future, you will find the "Edu-Kit" an excellent investment.

Many thousands of individuals of all ages and backgrounds have successfully used the "Edu-Kit" in more than 75 countries of the world. The "Edu-Kit" is a carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to learn yourself at your own pace. No instructor is necessary.

Progressive Teaching Method

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics teaching. The "Edu-Kit" uses the modern educational principle of "immersion-learning." You begin to study immediately after you construct your first circuit, progressively advancing until you are using the latest available techniques. You begin by examining the various radio parts of the "Edu-Kit." You then learn the theory and practical operation of these radio parts. With this in mind, you will enjoy listening to regular broadcast stations, learning theory, practice testing and experimenting with radios that you build. We have advanced the theory of electronics and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself building more advanced multi-tube radio circuits and doing work like a professional Radio Technician.

"Edu-Kits" are taught in an individualized course of sixteen Receiver, Transmitter, Code Oscillator, Signal Tracer, and Signal Injector circuits. These circuits are the backbone of modern radio, the know-how of building the radio of tomorrow. These circuits are not taught in a book or a book is not necessary.

"Printed Circuitry." These circuits operate on your regular AC or DC home current.

The "Edu-Kit" is complete

You will receive all parts and instructions necessary to build 16 different radio and electronic circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable electrolytic and paper dielectric capacitors, resistors, tie strips, collars, hardware, tubing, punched metal chassis. Instruction Manuals, wire, solder, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, a professional electric soldering iron, and a self-powered Dynamic Radio & Electronics Tester. The "Edu-Kit" also includes Code Instructions, Printed Circuit Oscillator, Printed Circuit Code Oscillator, in addition to FCC-type Questions and Answers for Radio Amateur License training. You will also receive lessons for the "Edu-Kit" Radio Progress. Printed Circuit Signal Tracer and the Progressive "Edu-Kit" includes a High Fidelity Guide and a Quiz Book. You receive all parts, tools, instructions, etc. Everything is years to keep.

Unconditional Money-Back Guarantee

At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a complete Printed Circuit Signal Injector, a unique servicing instrument that can detect many Radio and TV troubles. The revolutionary new technique of Printed Circuit construction is now becoming popular in commercial radio and television.

Printed Circuit is a special insulated chassis on which has been deposited the Printed Circuit material which takes the place of wiring. The various parts are merely plugged in and soldered to terminals.

Order Direct from Ad—Receive Free Bonus

We are able to offer this bonus at no extra cost because we sell direct to the public.

Order at Once

This offer will expire on December 31, 1957.

Progressive "Edu-Kits" Inc.

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**BUILD ALLIED knight®-kits**

the finest electronic equipment in money-saving kit form

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**knight-kit “Trans-Midge” Transistor Receiver Kit**

Model Y-767

$2.45

Tiny, cigarette-pack size 1-transistor radio kit—fascinating to build. Covers the local AM broadcast band with exceptional sensitivity and selectivity. Features: ferrite core tuned coil; low-drain transistor operating for months from single penlight cell; handsome plastic case. Complete with all parts, transistor, battery and easy-to-follow instructions. (External antenna required.) A wonderful value. Shpg. wt., 8 oz.

Model Y-767. Net only. $2.45

J-149. Headphones. 1½ lbs. $2.15

C-100. Antenna Kit. 1½ lbs. $1.03

---

**knight-kit 5-Transistor Superhet Portable Radio Kit**

Model Y-766

$29.95

Handsome, easy-to-build personal portable with every ultra-modern design feature: 5 transistors (up to 200 hours playing time from 9v. battery supplied); printed circuit for easy building; big 3½" speaker, push-pull audio output; built-in ferrite loopstick antenna. Sensitive reception of AM broadcast band with exceptional tone. In ultra-smart high-impact ivory plastic case with handsome gold trim; size only 7½ x 334 x 1¼". With all parts, transistors, battery and instructions. Shpg. wt., 2 lbs.

Model Y-766. Net only. $29.95

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**knight-kit 10-Circuit Transistor Lab Kit**

Model Y-299

$15.75

Sensational transistor hobby kit! Assemble the basic parts once, then complete project after project (10 in all), just by plugging leads into proper jacks on printed-circuit board—no wiring changes needed. Make the following: AM radio; amplifier; wireless oscillator; code practice oscillator; electronic timer, switch or flasher; voice-operated, capacity-operated or photoelectric relays. Includes all parts, 2 transistors, battery, headphones, instructions for each project. Shpg. wt., 3 lbs.

Model Y-299. Net only. $15.75

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**knight-kit 2-Transistor Pocket Radio Receiver Kit**

Model Y-262

$14.65

It’s fun to build this pocket-size two-transistor radio—enjoy loud, clear local broadcast-band reception wherever you go! Completely self-contained with built-in ferrite loopstick antenna—no external antenna needed. Extremely efficient reflex type 2-transistor circuit actually does the work of 3 transistors! Printed circuit board reduces building time to about one hour. Has air-dielectric variable capacitor for easy, accurate station tuning. Operates for months and months on long-life alkaline battery supplied. Sensitive miniature earpiece provides remarkably fine tone. Complete with all parts, including plastic-impregnated case, earpiece, battery and transistors. 4 x 3¾ x 1¾". Shpg. wt., 1½ lbs.

Model Y-262. Net only. $14.65

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**knight-kit Transistorized Code Practice Oscillator Kit**

Model Y-229

$3.95

Advanced-design code practice oscillator—ideal for beginners learning the code. Uses transistor circuit—operates for months from a single penlight battery. Has clear, crisp tone of approximatley 500 cycles. Includes jacks for headphone tips; screw terminals for key. Compact black bakelite case with aluminum panel, only 2 1/4 x 3 3/4 x 1 1/2". Complete with all parts, transistor, battery and step-by-step instructions for quick, easy assembly. (Less earphones and key.) A fine code practice kit at very low price. Shpg. wt., 1 lb.

Model Y-229. Net only. $3.95

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**knight-kit Photo-Electronic Relay Kit**

Model Y-702

$13.50

Advanced-design, ultra-sensitive photo-electronic relay—build it yourself and save! Covers 250-ft. with white light; 125-ft. with "unseen" (red filter) light (made available in Light Source Kit listed below). Ideal as announcer, counter, burglar alarm (can be set to ring bell continuously when beam is broken). Hundreds of uses. SPST relay contacts. 6.3v. terminals provide power for accessories. 105-120 v. 50-60 cy. AC use. 6 lbs.

Model Y-702. Relay Kit. Net. $13.50

Model Y-703. Light Source Kit. With long-life sealed beam bulb and red filter. Shpg. wt., 3 1/2 lbs. Net. $6.75

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**knight-kit 2-Way Intercom System Kit**

Model Y-295

$14.75

Easy to build—ideal for home or office. Consists of Master and Remote unit, each with press-to-talk switch. Remote can be left "open" for switchless answering and baby-sitting. In "closed" position, Remote is private", but can be called and can originate calls. High-gain 2-stage amplifier and 4" PM speakers. Delivers full volume from only a whisper. With tubes and 50-ft. cable (up to 200-ft. may be added). Antique white finish. Size each unit, 4 1/2 x 6 1/2 x 4 3/4". For 110-120 v. AC or DC. Shpg. wt., 8 lbs.

Model Y-295. Net only. $14.75

---

**knight-kit "Space-Spanner" Bandswitching Receiver Kit**

Model Y-243

$15.95

Thrilling 2-band receiver, easy to build. Fun to operate—a terrific value. Bandswitch selects exciting short wave, including foreign broadcast, amateur, aircraft, police and marine radio (6.5 to 17 mc), and standard broadcast. Features highly sensitive regenerative circuit. Includes built-in 4 PM speaker and beam-power output for strong volume. Headphone connectors are available for private listening; switch cuts out speaker. Kit includes calibrated panel, punched chassis, all parts and tubes (less cabinet). Easy to build from step-by-step instruction manual. 7 x 10 x 6". For 110-120 volt, 50-60 cycle AC or DC. Shpg. wt., 5 lbs.

Model Y-243. Net only. $15.95

Y-247. Matching cabinet for above. $2.90

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**HOBBYISTS! YOU GET THE WIDEST CHOICE IN ALLIED knight-kits—MOST FUN TO BUILD!**

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Y-261 $2.15

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Y-705 $9.50

PHONO OSCILLATOR KIT

Y-760 $5.85

PHONO AMPLIFIER KIT

Y-790 $9.45

ELECTRONIC PHOTOFLASH KIT

Y-244 $28.50

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December, 1957
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Model Y-786
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Here is a custom-styled, easy-to-build complete Hi-Fi amplifier at unbeatable low cost. Features 8 inputs for every possible signal source, including NARTB equalized tape head input. Delivers full 18 watts output at only .5% distortion; uses new RCA 6973 hi-fi output tubes; frequency response, ± 1 db, 20-30,000 cps, tape head and magnetic cartridge sensitivity, 5 mv for 18 watts output; hum and noise level below 60 db below 18 watts; output taps for 4.8 or 16 ohm speakers. Separate bass and treble controls; full record equalization. Simplest assembly is made possible through use of exclusive printed circuit switch and two printed circuit boards—no critical wiring to do. With beautifully styled custom cabinet: 4 x 13 x 8'. Complete with cabinet, tubes, step-by-step instructions. Shpg. wt., 15 lbs.

Model Y-786. 18-Watt Hi-Fi Amplifier Kit. Not only ............. $39.95

knight-kit Complete 30-Watt Hi-Fi Amplifier Kit

Model Y-762
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Comparable to the best—and you SAVE MONEY! Advanced features include: Linear-deluxe, Williamsontype circuit; equalization for all records within 1/2 db of recommended accuracy; 2 exclusive new printed-circuit switches; 3 printed-circuit boards for time-saving, error-free assembly; separate continuously variable Level and Loudness controls; 8 inputs for every signal source; DC on all filaments of preamp tubes; exclusive 3-way speaker selector switch (use speakers of mixed impedances without mismatch!); Power Amplifier response, ± 1/2 db, 15,000-100,000 cps at full 30 watt level; distortion—harmonic, 0.55% at 30 watts—IM, 0.74% at 20 watts; rumble filter switch; variable damping. Output 8 and 16 ohms. With cabinet, 4 x 15 x 15". Ready for easy, money-saving assembly. Shpg. wt., 32 lbs.

Model Y-762. 30-Watt Hi-Fi Amplifier Kit. Not only ............. $76.95

knight-kit FM-AM Hi-Fi Tuner Kit

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The best-looking, best-performing FM-AM tuner your money can buy! Covers full AM broadcast and 68 to 108 mc FM. Sensitivity is 2.5 microvolts for 20 db of quieting on FM; 3 microvolts for 10 db signal-to-noise ratio on AM. Features include: Inertia Flywheel Tuning for easy, accurate tuning; Automatic Frequency Control (plus AFC disabling) to "lock-in" FM stations; printed circuit board for time-saving, error-proof assembly; pre-aligned RF and IF boards; tuned RF stage on compensated oscillator; neon glow tuning pointer; cathode follower output; two output jacks—one for recorder, one for amplifier. Built-in AM ferrite antenna. Ideal for use with knight-kits above. Includes handsome, custom-styled 3-44 in., 13 x 8". Ready for easy assembly. Shpg. wt., 12 lbs.

Model Y-787. FM-AM Hi-Fi Tuner Kit. Not only ............. $49.95

knight-kit 2-Way "Ducted Port" Complete Speaker System Kit

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BIG SAVINGS—assemble your own quality KNIGHT-KIT 2-Way Speaker System—it's easy! Cabinet is pre-finished—you just assemble 7 pieces, mount the speaker components, mount the speaker components, mount the speaker components, mount the speaker components, mount the speaker components, mount the speaker components, mount the speaker components, mount the speaker components, mount the speaker components, mount the speaker components, mount the speaker components, mount the speaker components, mount the speaker components, mount the speaker components. Special Jensen-engineered baffle features "ducted port" construction to enhance bass response. Kit includes Jensen 12" woofer and compression-type tweeter; genuine L-pad control permits adjustment of tweeter for best tonal balance. Impedance, 8 ohms. Assembled unit delivers frequency response of 25-14,000 cps. Enclosure measures 26 x 19 x 14". Kit includes everything required for easy assembly. Specify blonde or mahogany finish when ordering. Shpg. wt., 33 lbs.

Model Y-789. 2-Way Speaker System Kit. Not only ............. $49.95

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Always say you saw it in—POPULAR ELECTRONICS
knight-kit Deluxe Hi-Fi Preamplifier Kit
Sensational Hi-Fi design at new low cost! Features precise record equalization guaranteed within 1/2 db of recommended accuracy! Exclusive new printed-circuit switches and 2 printed-circuit boards for easy, error-free assembly; built-in power supply; response, ± 0.5 db, 10-120,000 cps, 8 inputs (including Tape Head); separate Bass and Treble controls; separate Level and Loudness controls; Rumble Filter switch; DC on all tube filaments; cathode follower output. Beautiful custom-styled case, 4 x 13 x 8". Complete with case. Shpg. wt.. 12½ lbs.
Model Y-754, Preamplifier Kit. Net only... $39.95
Model Y-755 $44.50
  Only $3.15 down

knight-kit 25-Watt Basic Hi-Fi Amplifier Kit
Here's superb Hi-Fi performance at less than half the cost of a commercially assembled unit. Williams-
on-type linear-deluxe circuit delivers full 25 watts of virtually undistorted reproduction; use with KNIGHT-KIT preamp above. Printed circuit board. Response: ± 0.5 db, 10-120,000 cps at 20 watts. Distortion: 0.15% at 30 watts. Output impedance: 4, 8 and 16 ohms. Includes balance control, variable damping control. Chrome-plated chassis; virtually undistorted reproduction; 1958 4 x 8". Ready for easy assembly. Shpg. wt.. 25 lbs.
Model Y-755, 25-Watt Amplifier Kit. Net only... $44.50
Model Y-759, Metal cover for above. Wt.. 3 lbs... $4.25

knight-kit Hi-Fi FM Tuner Kit
The last word in looks, quality, performance and low cost. Covers 88 to 108 mc; features Automatic Frequency Control (with special disabling circuit), fly-wheel tuning, pre-adjusted RF coils; pre-aligned IF's; cascode broad-band RF amplifier; drift-compensated oscillator; illuminated lucite pointer. Sensitivity is 5 microvolts for 20 db of quieting across entire band. Cathode follower output. Ideal for use with KNIGHT-KIT amplifiers on opposite page, or any amplifier with phono tuner switch. With custom-styled cabinet, 4 x 13 x 8". Shpg. wt.. 12 lbs.
Model Y-751, Hi-Fi FM Tuner Kit. Net only... $38.95

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featuring the complete KNIGHT-KIT line
See ALL the money-saving ALLIED KNIGHT-KITS—Hi-Fi, Hobby, Instrument and Ham Kits—in the BIG 1958 ALLIED Catalog. For the best values in Kits, for everything in Electronics—get this 404-page Buying Guide now.

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December, 1957
**ANOTHER HUM CURE**

If hum develops in a regenerative receiver or preamplifier which uses a transformer-powered selenium B+ supply, it can sometimes be cured simply by reversing the transformer's high-voltage secondary leads. The dashed lines in the schematic indicate the original wiring. The lead which previously went to the chassis should be connected to the rectifier terminal, and the lead which went to the rectifier connected to chassis.

---

**Simplified Subminiature Wiring**

Transistor circuit wiring can be kept to a minimum by using the insert contacts of subminiature sockets as clips. Temperature-sensitive components can be quickly and securely joined without heat, solder or the risk of damage.

---

**Crayons for Color Coding**

You can prevent mix-ups in wiring when only plain or single-color radio hookup wire is at hand. Color-code your wire by rubbing it with ordinary wax crayon. A small box of crayons contains eight or more colors. If still more are needed, use two colors on the same wire.

---

**Novel Speaker Repair**

In the course of normal handling, speakers with aluminum high-frequency caps may develop minor dents in their delicate
EXPERIMENTERS, HOBBYISTS, ENGINEERS!

You should have **VOLUME II** of the

RAYTHEON

TRANSISTOR APPLICATIONS BOOK

Volume II of the Raytheon Transistor Applications Book contains a wide variety of new applications never before published. And, like popular Volume I, it's more than a collection of circuits, it contains complete construction information including wiring diagrams, illustrations and parts lists. It has complete sections on receivers, amplifiers, ham gear, test equipment and a full section devoted to a number of interesting and useful transistorized gadgets.

There is a full section on basic transistor theory and circuit design, too, plus a section of installation and wiring hints on transistors and a lot of information on printed circuitry.

Whether or not you have Volume I, if you experiment with transistors you should have Raytheon Transistor Applications Book, Volume II. Get it from your Raytheon Tube Supplier or send 50¢ to Raytheon, Department V2.

RAYTHEON MANUFACTURING COMPANY

Receiving and Cathode Ray Tube Operations

Newton 58, Massachusetts

December, 1957
diaphragms. A dent can be removed without major effort by using the sticky end of a Band-Aid. Press the adhesive gently to the "wound," then pull it out. —D.L.S.

EXPERIMENTAL PARTS FROM STARTERS
Need a neon-glow lamp and some other parts for experiments? Then save those plug-in starter switches that are used with fluorescent lamps. Each starter contains a neon-glow lamp, a thermo-switch, and a small paper capacitor. The outside aluminum housing and inside insulating sleeve also have many uses. —J.A.C.

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To straighten the bent pigtail leads of capacitors or resistors, lay the wire lead on the edge of a flat surface and roll a flat block of hardwood over it with moderate pressure. This trick is handy for wires to be used in circuits at very high frequencies where bends add inductance. —J.A.C.

STRANDED WIRE INSTALLATION
Because individual strands have a tendency to separate, many experimenters avoid the use of stranded wire. The military services, however, prefer stranded to solid hookup wire because of stranded wire's greater flexibility and resistance to vibration. For special jobs, you can do a neat wiring job by following their procedures.

(Continued on page 109)
The famous Electro-Voice SP12B RADAX coaxial speaker economically delivers the smoothest, widest range available in any loudspeaker in its price class. This is paralleled by its superb efficiency, which means full, distortion-free sound with less power from the amplifier. When these qualities are combined with the wide polar distribution afforded by the second RADAX cone element, you have fine listening pleasure—

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Always say you saw it in—POPULAR ELECTRONICS
IF YOU OWN an electronic musical instrument or a conventional instrument equipped with a pickup, chances are that the vibrato described in this article is just what you've always wanted.

A vibrato is a device which continuously and automatically varies the amplitude of the music at a low rate of speed, usually somewhere in the range of 6 to 15 times per second. For instance, it is a vibrato which produces the soul-stirring throbbing, especially in the bass notes, of a pipe organ.

Construction. Layout and wiring are not especially critical. For convenience a turret socket was used to mount the oscillator tube, V1, and its components, but a standard socket and tie points will do as well.

Miniature coaxial jacks, of the type found on most hi-fi amplifiers, were used at J1 and J2 for the output and input con-
nections, respectively. If your setup requires something different, any conventional type of jack may be employed.

Keep the power supply components well separated from the oscillator and modulator components, to prevent hum pickup—and orient the tube sockets for reasonably short lead connections. Make sure that the 6.3-volt heater leads are dressed snugly against the chassis and that they are well separated from grid terminals and leads.

A miniature amplifier foundation (Bud No. CA-1754) was used for a chassis (any other setup of suitable size can be substituted). The Bud chassis measures 5" x 7" x 2", and its over-all height with the grille cover in place is 6". The finish is black crackle—but if some other color appeals to you, it's a simple matter to go over the chassis with a couple of coats of plastic spray.

In some instances, it may be possible to mount the vibrato circuit proper on the same chassis with the musical instrument amplifier. This can be done provided that there is room, and that the power transformer in the amplifier can supply the 0.6-ampere additional filament current de-

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**PARTS LIST**

| C1, C2, C3, C5-0.05µfd., 200-volt, metalized paper capacitor |
| C4a/C4b-20/30-µfd., 150-volt, dual electrolytic capacitor |
| C6, C7, C9-0.02-µfd., 200-volt, paper capacitor |
| C9a/C9b-40/40-µfd., 250-volt, dual electrolytic capacitor |
| CH1-3.5-henry, 50-ma. filter choke |
| J1, J2-Miniature phono jack |
| R1, R4, R7, R8, R10-220,000-ohm, ½-watt resistor |
| R2, R6-100,000-ohm, ½-watt resistor |
| R3-500,000-ohm potentiometer (Rate control) |
| R5-10,000-ohm, ½-watt resistor |
| R9-3.3-megohm, ½-watt resistor |
| R11-500,000-ohm potentiometer (Depth control) |
| R12-27,000-ohm, ½-watt resistor |
| R13-560-ohm, ½-watt resistor |
| R14-47,000-ohm, ½-watt resistor |
| R15-470,000-ohm, ½-watt resistor |
| S1-S.p.s.t. switch (on Depth control) |
| S11-20-ma., 130-volt selenium rectifier |
| T1-Miniature power transformer, 125 volts at 15 ma., 6.3 volts at 0.6 amp. (Stancor PS-8415) |
| V1-Type 12AX7 tube |
| V2-Type 12AU7A tube |
| I-Miniature amplifier foundation chassis or equivalent (see text) |
| I-Turret-type miniature 9-pin tube socket |
| Misc. hardware, grommets, tie points, etc. |
Top and bottom views of the vibrato chassis are seen at left and below. Twist the lugs of the can-type filter capacitors so that the filters are tight to their metal mounting plates.

Schematic and pictorial at left show the simplicity of the vibrato construction. If your amplifier tends to "thump" at vibrato frequency, try a lower value capacitor for C7.
**Block diagram** shows correct interconnection of the three basic components of the revised setup. Use shielded microphone cable between units to prevent electrostatic hum pickup. If there seems to be excessive 60-cycle hum present, try reversing line plug of either amplifier or vibrato unit.

manded by the two vibrato circuit tubes. The plate voltage requirement is approximately 175 volts.

**Hooking It Up.** The vibrato is intended to be inserted or connected between the musical instrument and its amplifier. All you have to do to use it is unplug your musical instrument from its amplifier and plug it into the input jack of the vibrato. Then connect a jumper cable of convenient length between the output jack of the vibrato and the input jack of the amplifier.

The **Rate** control determines the rate or frequency of the vibrato effect, i.e., the speed at which the rise and fall in amplitude occurs. Proper setting of this control depends upon the type of instrument with which the vibrato is used and the type of music being played. Component values given in the parts list permit the unit to be adjusted over the most useful range of speeds.

The **Depth** or vibrato-frequency gain control determines the amplitude of the

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**POSSIBLE TROUBLES AND CURES**

**No Vibrato Effect:** Check all wiring for errors. Make sure input and output plugs are making good contact in the jacks. Look for faulty components. Check the tubes. Make sure the 12AX7 tube is in the oscillator socket, the 12AU7 in the modulator socket, and not vice-versa. Check interconnecting cables for a poor solder joint or broken wire.

**Distortion:** Most, if not all, vibratos cause a certain amount of distortion. However, the effect should not be objectionable. Reduce the setting of the Depth control slightly to see if it improves the condition. If so, check the musical signal voltage at the input to the modulator. An input greater than 0.7 volt r.m.s. may cause distortion. Check the value of components around the modulator. Look for a possible defective component. And check the modulator tube.

**Thumping in Speaker:** A thumping noise at the vibrato rate may be due to low frequencies pulling the voice coil or cone out of line. This isn’t likely to happen unless you have an amplifier with exceptionally heavy bass response. A high-pass filter cutting off at about 100 cycles inserted between the vibrato and the amplifier may be necessary in such cases if all else fails.

**Hum:** Hum can come from a variety of sources such as a poor layout of components, excessively long leads or poor lead dress, a defective modulator tube, faulty filter choke or capacitors, unshielded interconnecting cables or cables with the shield ungrounded to chassis, using the unit close to power wiring carrying heavy a.c. currents, etc. All of these possible troubles can be easily corrected.

**How It Works**

The schematic shows that the vibrato consists of two parts: (1) a very low frequency audio oscillator, and (2) a modulator. The low-frequency oscillator is of the phase-shift type which uses resistors and capacitors C1, C2, C3, R1, R2 plus R1, and R4 in three RC sections to obtain feedback in the proper phase to produce oscillations. The rate or speed of the vibrato, i.e., the frequency of the oscillator, is determined by the resistance and the capacitance used in the RC sections. Thus, R3 is the **Rate** or speed control of the vibrato.

115's second triode section serves a dual purpose: (1) it provides a low source impedance for the RC feedback loop (taken from the cathode, and (2) it acts as a buffer to isolate the oscillator from the connection to the modulator (taken from plate).

The low-frequency oscillator signal is fed through the gain or **Depth** control, R17, to the control grid of one section of the twin-triode modulator, F2. At the same time, the output signal from the musical instrument is fed through the control grid of the second section. The two signals mix in F2, with the result that the gain or amplification of the musical signal is made to increase and decrease, smoothly and periodically, at the rate of the low-frequency oscillations. Output from the modulator is taken through C7 and coupled to the input of the musical instrument's conventional amplifier.

Plate current demand is very small, so a miniature power transformer, T1, and a miniature selenium rectifier, SK1, more than meet the requirement.

*Maximum musical signal voltage should not be greater than approximately 0.7 volt, to prevent overloading the unit. Optimum operation occurs with a musical signal input from the contact microphone between 0.3 and 0.7 volt.
SO YOU'VE got the lights strung on the tree, and the yuletide decorations in the windows, and just about everything else you can think of is in place to add to your Christmas cheer, but you're still not satisfied. You want something a little different from your next-door neighbor's.

Ah, well, if you're really determined, POP'tronics, in the spirit of Christmas giving, offers this inexpensive little tinkler for you to build in a few hours of your spare time before the holiday rolls upon you. You'll be surprised at the excitement it will cause—particularly if you hang a bit of mistletoe from it as a lure for the gals.

While the unit contains three bells, you may use more or less, as you desire. Note that separate transformers are used for each bell, rather than a single transformer. Since it is best to break the circuit in the primary to prevent TV interference and also to have each bell operate independently, a flasher button and a separate transformer are the best combination.

And, fortunately, there are suitable transformers available which may be purchased in lots of three at a price comparable to that of one transformer capable of operating three bells.

Tinkle in Oscillation. The bell unit consists of three solenoids in which steel plungers attached to bell clappers move up and down, causing the clappers to hit the sides of the bells. Due to the action of the flasher buttons in the primary circuit of the transformers when the circuit is closed, the plungers oscillate up and down several times before coming to rest. This action produces a very pleasing tinkling.

Each solenoid is wound on a form 2" long with an inside diameter of about \(\frac{3}{8}\)", as shown on page 47. Cardboard, plastic, fiber, or other insulating material may be used for the form. Or a piece of \(\frac{7}{8}\)" wood dowel with the center drilled out may be used for the tube through which the plunger operates. Wind each solenoid with 18 layers of No. 26 insulated magnet wire. If a lathe is not available for winding the coils, a hand drill placed in a vise will make a very satisfactory substitute. The plunger consists of a piece of soft steel rod, drilled and tapped for a 6-32 machine screw to a depth of \(\frac{1}{2}\)".

The bells are mounted on a wood base, 2" wide and 12" long. These bells are the type usually sold in dime stores. They have a diameter of 2" and a height of \(1\frac{1}{2}\)". There are other bells which may be used.
If you don’t have a lathe for winding solenoids, you can do a good job with a hand drill placed in a vise. See text for the proper coil size.

Preparing the Bells. Remove the handles and clappers from the bells and drill ¼” holes through the bells on one side, near the top, so that a piece of light bulb socket chain will pass through hole freely. Before securing the bells to the wood base, drill ½” holes through the wood base through which the solenoid plungers will move. These holes should be located so that they will be directly over the ¼” holes in the bells when the bells are secured to the wood base. Glue the solenoids to the wood base, then secure the bells in position with ⅛” spacers and wood screws. The spacer will allow the necessary space for the plunger to move in and out of the solenoid.

Insert a machine screw on which a nut and washer have been placed in the threaded end of the steel plunger, as shown in the drawing. Solder a piece of light bulb socket chain about 1” long to the opposite end of the plunger. Solder pieces of spring brass in which No. 34 holes have been drilled to the ends of the clappers, so that the clappers may be attached to the ends of the chains. Attach miniature light bulb sockets to the wood base directly in front of the solenoids. Connect the solenoids and sockets according to the wiring diagram.

Make a metal housing for the unit with ⅛” holes drilled directly over the plungers. The face of the housing may be made of cardboard through which a suitable greeting, such as “Welcome” or “Merry Christmas,” or figures may be cut and illuminated from within by means of colored light bulbs or colored cellophane backing. The unit constructed by the author uses green and red stars with a very pleasing effect.

The Power Supply. The power unit consists of 20- or 24-volt transformers and small flasher buttons. All of the trans-
Side view of flasher button as it is held between spring brass brackets on one transformer.

Completed solenoid plunger with bell clapper secured to end of chain. Clapper may be removed easily to allow plunger to be inserted into the solenoid. Note how length can be varied by nut and washer.

Bell unit with front removed to show solenoids and miniature lights. Terminal strips at right of coils prevent breakage of the solenoid leads.

Transformers may be controlled by one switch, or each by a separate switch. The flasher buttons are mounted on the transformers by means of three-terminal tie points and spring brass brackets, as shown on the drawing. A four-wire cable completes the circuit to the solenoid unit. A four-wire socket and plug at either end of the cable will provide for more convenient handling of the unit. The power supply should be enclosed for safety.

With the flasher buttons in place and 20-volt lamps in the sockets, the unit is ready for preliminary adjustment. Connect the power supply to 117 volts, a.c., and adjust each plunger and each length of socket chain for the desired sound from the corresponding bell. If you want a different tone from each bell, you can slot the edge of the bell with a hack saw. Adjust the plunger by turning the nut on the machine screw up or down.

Dimensions of various pieces.

December, 1957
The Fine ART of MEASUREMENT

A NEW ERA has dawned in the fine art of measurement. AccuRay, a device which uses atomic rays as a control, can measure with unheard-of precision any material that goes through a roller or a pipe. This means that metal, paper, rubber, plastic—you name it—can be processed with a fineness that by 1961 will save industry a billion dollars a year. How it works is amazingly simple.

The machine usually consists of two arms. The "hot" arm is mounted beneath the moving material to be gauged, the other above it. In the lower arm is a radioactive isotope pellet, whose rays penetrate the sheet and are detected by a counter in the upper arm. The thickness of the sheet, or tube, determines the amount of radiation getting through.

Let's assume that the process is going along smoothly, and that the sheet is being rolled at precisely the correct thickness. Suddenly, the tension of the rollers changes imperceptibly—a common occurrence—and the thickness is changed by a fraction of an inch. In that instant, the number of rays reaching the counter changes, either up or down, according to whether the sheet is thicker or thinner. In a fraction of a second, the counter flashes a warning to the control to which it's linked, and the rollers are adjusted back to their original tension. This is automatically indicated on a recorder hooked up to the device, so that a permanent record of accuracy is kept.

One of the most publicized uses of AccuRay is in the control of cigarettes. Here the long tube of tobacco-filled paper passes between the jaws of the machine (above). If there is a variance of a fraction of a degree in the amount of tobacco in the tube, AccuRay rejects it automatically, and has the cigarette machine reset to give the proper weight of the tobacco in the following cigarette tube.

Another important use of the device is in the making of tires. Heretofore it has been difficult to get a precisely balanced tire, since the weight of the rubber as it was being rolled varied by more than the tolerance needed. With AccuRay, this changed—tire rubber is being held to accurate tolerance, and tires are being made both cheaper and better.
PRINTED circuits have come of age. Today they are an integral part of almost all electronic equipment. Look at the nearest device: if it has been made in the past year, the chances are that in it you will find printed circuits or components.

Some of the newest uses for printed circuits are in the instrument cluster connections in an auto dashboard (see photo above). Guided missiles have compact, reliable controls which use printed circuits, and so do midget tape recorders, jet planes, hearing aids, electronic organs, and hundreds of other devices.

The most common type is an insulating board* with a pattern of conducting wires (below right). A photo or printing process transfers the design to the copper-clad base and an etching process removes the excess copper, leaving the circuit. In other methods, the conductors are built up on the insulated base. Next step is the placement of components, handled mechanically. In one machine all heads are controlled simultaneously, and as the board is positioned, all the capacitors and resistors are inserted in one operation. In another machine, they are inserted one at a time as the board moves down the line. After the components are inserted, all parts are dip-soldered in place in a single operation.

The use of printed circuits has led to the development of modules. These are complete circuits such as audio amplifiers, cathode followers or pulse generators.

Modules are built on a single board as a unit, acting as a standard circuit which can be used in different end products. Figure 1 on the next page shows an experimental TV receiver built of 17 modules which hold 153 of the 195 components (resistors, capacitors, etc.) exclusive of the tuner. Other modular construction is of the type in Fig. 2. These are plug-in boards as used in many computers and industrial controls. Tube and tubeless types with diodes are shown.

These modules can be made up of smaller units. For example, several resistors and capacitors can make up a package—a “super component”—and can be used on a printed-circuit board (Fig. 3). In another way of treating the same situation, the components are encapsulated in phenolic material (Fig. 4). The newest development is flat Tape Cable (Fig. 5) which eases the task of interconnecting printed wiring (see October issue of POPULAR ELECTRONICS, p. 72).


December, 1957
If this works you’ll make hearing-aid history—"

Outgrowths of the simple printed circuit shown on the preceding page are the modules on these two pages. An excellent example of modules put to use is in an experimental television receiver (Fig. 1) which has 195 components plus the tuner. Of these, 153 parts are mounted in 17 modules, some of which can be seen in the photo. Industrial control modules are shown in Fig. 2. These are plug-in boards, both tube type and tubeless with diodes. Such modules can be made up of even smaller units—the so-called “super component”—as shown in Figs. 3 and 4 (at right). In Fig. 3, leadless resistors and capacitors are made up into a single pre-wired unit (small photo) which is then mounted on a small printed-circuit board (larger photo). Note how this arrangement saves space. Another way of doing the same thing is shown in Fig. 4. Here groups of components are encapsulated in phenolic cases. Units like this are found in most of today's television receivers. Each assembly is replaceable as one component. As an aid in interconnecting such modules, the new Tape Cable (Fig. 5) has been developed in the past few months. To facilitate connections, plugs and sockets matched to the cable have also been developed, as shown in the same photo.
"Those the printed circuits you hear about?"
AND a Merry Christmas to you . . . together with the sincere wish that your Christmas Stocking will be brimming full with exactly what you would like old St. Nick to bring—be it a new car, new test equipment, or a whole cartload of transistors and miniature components.

In the past few weeks our mail has included a lot of letters asking about high-frequency operation of transistors. There's nothing especially mysterious about transistors at high frequencies. The circuits themselves are quite similar to those used at, say, AM broadcast-band frequencies (550 to 1500 kc.) except, of course, for the values of components in the tuned circuits. But the important thing is to have the proper type of transistor.

**High-Frequency Operation.** Tetrode transistors (see our May 1957 column) may be used up into the hundreds of megacycles. The highest frequency tetrode available at this writing is Texas Instruments' Type 3N25—this is a p-n-p unit with a cutoff frequency of 250 mc. General Electric, too, offers a whole series of tetrode transistors—the highest frequency unit is the 3N30, an n-p-n transistor with a cutoff frequency of 120 mc. RCA is currently offering the highest frequency triode transistor, the 2N384; this is a p-n-p unit with cutoff frequency of 100 mc. which may be used as an oscillator up to 250 mc.

In general, r.f. transistors will serve as amplifiers up to, or slightly past, their nominal "cutoff frequency" (at which their gain is approximately 70% of that achieved at low frequencies), and as oscillators well above cutoff frequency. Take the RCA transistor as an example. With a cutoff frequency of 100 mc., this unit will provide 15 db gain at 50 mc. in a common base amplifier circuit. It provides unity gain at 250 mc.

The lowest priced high-frequency transistor as far as the home experimenter is concerned is probably Philco's Type AO-1 surface barrier transistor. With a rated cutoff frequency of 30 mc., the AO-1 is offered at slightly under $2.00 by leading mail order supply houses.

All of these transistors are suitable for receivers and low-power transmitters. Unfortunately, no manufacturer is currently offering medium or "hi" power transistors for use at high r.f. values.

**Readers' Circuit.** One- and two-transistor receiver circuits are extremely popular with home builders. Almost all such circuits featured in past columns have used either detector-amplifier or simple regenerative-detector arrangements. These circuits, at best, have limited sensitivity and, usually, just fair selectivity.

This month, however, we have a most interesting "maximum performance" two-transistor receiver circuit. Submitted by

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**Fig. 1.** Reader Gerald Le Fevre's two-transistor superheterodyne receiver.
Gerald Le Fevre, of York Rd., Pavilion, N.Y., as his "favorite," this receiver has a superheterodyne circuit. In addition, it uses a reflex arrangement, permitting one transistor to serve both as an i.f. stage and as the audio amplifier. Coils L1 and L8 are Miller Types 2000 and 2020 respectively.

Referring to Fig. 1, you will see that a Sylvania Type 2N94 r.f. transistor serves as a combination mixer-local oscillator. The i.f. output signal developed across the primary of transformer T1 is coupled to the i.f. amplifier stage, a second 2N94. T1 is a Miller 2041.

The amplified signal then goes from i.f. transformer T2 (Miller 2042) to a 1N34A diode, which serves as the second detector. The resulting audio signal, appearing across volume control R8, is "reflected" back to the i.f. stage through audio coupling transformer T3. Finally, the amplified audio output signal is applied across a pair of headphones. (T3 is an Argonne AR-100.)

Base bias for the first stage is supplied by voltage divider R1-R2, operating in conjunction with emitter resistor R4, bypassed by C5. Base bias for the second stage is supplied by voltage divider R5-R6 and emitter resistor R7, bypassed by C7. R6 is bypassed by C6; other r.f. bypass capacitors are C4, C8, and C9. Operating power is supplied by a standard 6-volt battery, B1 (such as a Burgess Type Z4).

Construction should pose no problem for the experimenter who has assembled other simple transistor receivers. Gerald assembled his unit on a 4" x 4" chassis, but suggests that a small Masonite board will serve as well. A Miller #2112 two-gang unit serves as tuning capacitor (C1a/C1b). All resistors are ½-watt units, while all fixed capacitors may be small disc ceramics or paper tubulars.

If you assemble one of these receivers, be sure to keep your layout as "clean" as possible, with all signal leads short and direct. Watch the battery polarity . . . remember that the 2N94 is an n-p-n transistor! Moderate-impedance (2000 to 4000 ohm) magnetic headphones should be used.

You shouldn't need an external antenna for stronger local stations. However, for additional pickup, try connecting an antenna to the "hot" side of the ferrite antenna coil (L1) through a 200-µfd. ceramic or mica capacitor.

To align the unit for best operation, use a standard r.f. signal generator. With a modulated r.f. signal, peak the i.f. transformers for maximum output at 455 kc. Adjust the oscillator trimmer capacitor (across C1b) for tracking at the high-frequency end of the dial (around 1500 kc.) and the paddler capacitor (C2) and oscillator "slug" (in L2) for tracking at the low-frequency end of the band (about 600 kc.), "rocking" the tuning capacitor as you do so. If an antenna trimmer capacitor is provided (across C1a), adjust this for maximum output above 1550 kilocycles.

High-Voltage "Generator." Reader Charles Rakes, of 4419 Harrison St., Kansas City, Mo., has submitted a pair of interesting applications for a high-voltage "generator" designed around a low-cost power transistor. Referring to Fig. 2, a CBS-Hytron Type 2N256 power transistor is connected as a modified "Hartley-

(Continued on page 122)
Internal and external views of tracer are shown on these two pages. The power transistor (TR4) should have its shell well insulated from chassis ground. The speaker is a special job requiring no output transformer when used with the 2N255 transistor.

With the possible exception of a volt-ohm-milliammeter, the signal tracer is perhaps the most useful test instrument in the home workshop. However, a.c.-operated signal tracers have always been handicapped by their sensitivity to 60-cycle pick-up. And battery-powered models, using vacuum tubes, have the disadvantages of high-battery drain, tube fragility and low audio output.

The "de luxe" model tracer shown here incorporates four transistors and a self-contained 6-volt battery and has almost 1 watt of audio available at the output of the CBS 2N255 power transistor.

Construction is simplified by using a standard aluminum chassis as a cabinet. A small individual subchassis for parts mounting is cut from a scrap piece of aluminum and bolted directly on the speaker. The power transistor is insulated from the chassis and plugged into a 9-prong miniature socket. All other transistors and parts are soldered directly into place as the circuit is wired.

Spaghetti is placed on the collector and base leads of each transistor to prevent shorts to other components or to the chassis. Parts placement is not particularly critical, but try to keep the input components away from the output circuit.

Note that this model tracer has two separate input jacks labeled respectively "phono" and "probe." The "probe" jack (J1) is the input for the r.f. detector lead. This probe contains a crystal diode which demodulates the r.f. signal and allows the transistor audio amplifier to build up the signal to audible level.

When testing in audio stages where less gain is required, use the "phono" jack input. This jack (J2) is fed by a shielded...
By HOMER L. DAVIDSON

Transistorized tracer avoids noise problems of most older models

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**PARTS LIST**

- **B1**—6-volt midget battery (RCA VS068)
- **C1, C2, C3**—10-pfd., 50-volt elec. capacitor
- **J1**—Chassis-mounting microphone connector (Amphenol 75-PC1M)
- **J2**—Phono jack (RCA type)
- **R1**—12,000-ohm, 1/2-watt carbon resistor
- **R2**—120,000-ohm, 1/2-watt carbon resistor
- **R3**—20,000-ohm, 1/2-watt carbon resistor
- **R4**—15,000-ohm volume control
- **R5**—100,000-ohm, 1/2-watt carbon resistor
- **R6**—47,000-ohm, 1/2-watt carbon resistor
- **R7**—220,000-ohm, 1/2-watt carbon resistor
- **R8**—270,000-ohm, 1/2-watt carbon resistor
- **S1**—S.p.s.t. switch (on R4)
- **TR1, TR2, TR3**—CK722 transistor (Raytheon)
- **TR4**—2N255 transistor (CBS)
- **Spkr.**—4" PM speaker, 45-ohm voice coil (Operadio—DuKane Corp., St. Charles, Ill.)
- **1**—7" x 5" x 3" aluminum chassis with back plate (Bud AC-429)

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December, 1957
HOW IT WORKS

Signal tracing is a "dynamic" test in that the equipment under test is in operation and has a signal going through it. The tracer is used to follow the path of the signal from input to output. The signal in the case of a broadcast receiver is a tuned-in station or an r.f. oscillator. For amplifier tracing, you can use an audio oscillator or phono player as a signal source.

The input signal is coupled to the base of the first, audio stage by a 10-µfd. capacitor (C1). The collector of TR1 is coupled to the base of the second audio stage through a 15,000-ohm volume control, R4. A phone jack (J2) installed at this point enables pickup from a crystal phono pickup head.

A 270-ohm resistor (R3) is used as an emitter load resistor, common to both TR3 and the output stage. TR4. The collector of TR3 is tied directly to the 6-volt power supply. As the output impedance of a 2N255 transistor is approximately 48 ohms, a 45-ohm voice coil speaker provides the proper collector load.

cable terminated on one end by a standard type phono plug and on the other by an isolating capacitor. For audio applications, such as crystal phono cartridge testing or hi-fi amplifier servicing, this input is best.

**Using the tracer** for trouble-shooting is simplicity itself. First turn the radio receiver on and tune it to a strong local station. Connect the signal tracer's ground lead to the receiver's chassis or "ground." Then turn the signal tracer on, adjusting gain control R4 for full volume. Starting at the receiver's antenna, the probe may be touched to the "input" and "output" of each stage to check individual stage operation.

If the program is heard at one stage but not at another, check the circuit between. Defective radios, hi-fi amplifiers, p.a. sys-

c-tems, TV receivers and intercom circuits should present no problems for this little transistorized signal tracer.

CROSSWORD PUZZLE

*By Arthur L. Branch*

**ACROSS**

1 Multiple of the fundamental frequency.
9 Types of tubes used as detectors.
11 Rectifier output current; Abbr.
13 To make a curve (graphically).
14 Chemical symbol for cobalt.
15 Resistance unit.
17 Suffix denoting one who does.
18 Unit of time; Abbr.
19 Exclamation.
21 Charge developed in a vacuum tube.
24 A short circuit may be caused by a _______ in the wires.
26 Sick.
27 Middle Eastern country; Abbr.
28 Chapter; Abbr.
30 Snake-like fish.
32 The: Fr.
33 Effective a.c. voltage equals mean - square voltage.
35 Continent; Abbr.
36 Kind of bird.
38 Devices used to pick up radio signals.

**DOWN**

2 Public notice.
3 Tear.
4 A burrowing animal.
5 Scents.
6 Total profit.
7 Exits.
8 Fuss.
10 Part of a transformer.
12 Stored electrical energy.
14 Periodic changes in current values.
16 Conductance unit.
20 Like.
22 The correct formula for inductive reactance is: \( X_L = \frac{2\pi fL}{X_L} \).
23 Beverage.
24 Device used to convert chemical energy into electrical energy.
25 Mark with a scribe.
29 Part of a loudspeaker.
31 Relation of the current to the voltage in an inductive circuit.
33 Rodent.
34 2000 pounds.
35 Practical nurse; Abbr.
37 Cathode-ray tube's pin connection; Abbr.

(See page 117 for solution)
Oscilloscope Traces

Radio-Frequency Measurements

Wherever signals go "on the air," these tests will
tell you their nature

By HOWARD BURGESS

WHENEVER some science fiction movie or TV show is intended to appear "ultra-scientific," or when a sponsor wants to clinch his sales pitch with some phony-technical display, chances are that an oscilloscope will be shown with a modulated wave pattern jumping around on the screen. Such 'scope traces are, as it were, the popular image of scientific work.

Perhaps this particular trace has gained its popularity because it is so useful. It can be immensely valuable to anyone working with a modulated carrier. The carrier need not be one of a high power transmitter. It can originate from a wireless record player, a service-man's signal.

Checking the carrier frequency of a portable transmitter by the techniques described here will assure its proper functioning when it is taken into the field.
The oscilloscope is coupled to the input and output of a frequency multiplier stage in order to check its operation.

Scope patterns created by an r.f. stage in the hookup described in Fig. 1: (a) without frequency multiplication; (b) with frequency doubling; (c) with frequency tripling; (d) with frequency quadrupling. These patterns provide a quick check for frequency multiplier stages.

Direct Connection. Very few amateurs own an oscilloscope with an internal amplifier able to pass the higher radio frequencies. However, in most cases this problem can be solved by feeding the r.f. signals directly to the deflection plates of the oscilloscope cathode-ray tube. Most oscilloscopes have these connections brought out to a small terminal board in the rear of the 'scope's cabinet. With the signal fed directly to the cathode-ray tube, traces can be obtained to well over one hundred megacycles.

One use of the oscilloscope which generally requires this type of connection is the checking of frequency multipliers in transmitters. Many of the modern transmitters, both amateur and commercial, have one or more frequency multiplier stages following the crystal oscillator. If the output of the transmitter is to be on the correct frequency, each multiplier stage must increase the frequency by the desired number of times.

Counting Loops. The output frequency of each stage can be checked with a good calibrated wavemeter if one is available. A double-check, and in many cases a better test, can be made with an oscilloscope. This method makes use of the Lissajous

pattern which is formed when two signals of different frequencies are applied to the vertical and horizontal plates of the tube. (See POPULAR ELECTRONICS, March, 1957, page 63.) If one set of deflection plates is coupled to the input of the multiplier stage under test and the other set of deflection plates is coupled to the output of the same stage (Fig. 1), the pattern formed will indicate the number of frequency multiplications taking place in the stage.

The pattern most likely to be formed will be found among those shown in Fig. 2. They range from a multiplication factor of
Fig. 3. The circular patterns produced by r.f. on the 'scope screen are shown here for three different cases: (a) no modulation; (b) 50% modulation, and (c) 100% modulation of the carrier frequency.

1 (shown at A) to factor of 4 (at D). For those who are not familiar with this type of trace, examination of the figure will show that the multiplication factor is found by dividing the number of loops in the width of a pattern into the number of loops in its height. All of these patterns are one loop wide. In many cases the loops will not be as rounded and clear-cut as shown here; however, it is the number of loops and not the shape that matters in this case.

Modulation Check. Anyone that works with electronic equipment for any length of time sooner or later finds himself confronted with modulation problems. Even the experimenter who is not a licensed amateur would like to be able to check the modulation of stations that he hears. If precise checking isn't necessary, the simple test to be described will be adequate. The setup in Fig. 5 will usually do the job.

The horizontal input to the 'scope is coupled to the plate of the last i.f. amplifier of the receiver through a small blocking capacitor. This added load will probably require a slight amount of retuning of the last i.f. transformer. The sweep generator in the 'scope must be turned off. Now connect the vertical input to the horizontal in-

Fig. 4. The trapezoidal pattern of r.f. as it appears with: (a) no modulation, (b) 50% modulation, (c) 100% modulation, and (d) overmodulation of the carrier frequency.
put through a 100,000-ohm potentiometer. Then, with a good strong signal tuned in on the receiver, adjust the vertical and horizontal gain controls of the 'scope and the variable resistor until a circle is produced on the screen.

**Circle Check Pattern.** If the signal is not being modulated, the circle will be a sharp, well-defined pattern. As soon as modulation is applied to the carrier, the circle will alternately expand and contract to form a pattern similar to a doughnut. As the percentage of modulation is increased, the hole in the center will gradually close until it is completely closed at 100% modulation. If more than 100% modulation is present, a bright dot will form in the middle. The circle should move out the same distance that it moves in toward the center.

**Caution:** Before alienating your transmitting friends by criticizing the signal they send out, make sure that the receiver you used for this test is in good condition. A properly modulated wave, upon passing through a poorly adjusted receiver, can appear either over-modulated or under-modulated.

This system can also be used to check the output of signal generators which are operating on frequencies too high to be fed directly into the oscilloscope. Phono oscillators and similar gadgets can be checked for percentage of modulation in the same manner. The oscillator is tuned in on the broadcast receiver and the 'scope connected to the i.f. system of the receiver as outlined above.

**Trapezoid Check Pattern.** Another modulation pattern which is formed in a manner similar to the circular trace is that of the trapezoidal figure. This type of measurement requires a direct power take-off from the transmitter tank and a sample of the audio used to modulate the transmitter. Because of this, it is not suitable for measuring the modulation of distant stations. The circular pattern serves that purpose.

However, for continuous monitoring of a transmitter, the trapezoidal pattern is the simplest to obtain since it requires no amplifier or sweep circuits. Connections are made directly to the deflection plates of the cathode-ray tube of the oscilloscope as shown in Fig. 6.

When the transmitter is not modulated, the r.f. carrier will produce only a vertical line. When modulation is applied, it furnishes the sweep to form a triangle as in A of Fig. 4. If transmitter is modulated less than 100%, the triangle will not be filled out, as at B. Too much modulation will form a pinched-off pattern, as at C, with a bright trailing line. If the sloping sides of the triangle are curved rather than straight, the transmitter under test is distorting due to nonlinear operation.

**General Hints.** There are many other r.f. measurements that can be made with the oscilloscope which may be discussed in future articles. Whenever the 'scope is used for r.f., it is a good idea to keep leads short, with as little shielding as possible. And don't jump at conclusions. You will see a good many "queer" traces during your first investigations but, with growing experience in interpretation, important clues about the condition of your radio-frequency equipment will be clearly revealed to you.

You will find that familiarity with radio-frequency traces will come in handy on many occasions. Wherever signals are actually sent out "on the air," it is necessary to check r.f. stages both at the transmitter and at the receiver, as well as to monitor the degree of modulation wherever the signal itself is more complex than simple c.w.

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**Fig. 5.** This simple circuit will usually produce a circular pattern at an i.f. frequency.

**Fig. 6.** Coupling the oscilloscope to produce a trapezoidal pattern on the screen.
The "telephone of the future" bowed in at the Radio, Television and Phonograph Exhibition in Frankfurt, Germany, in August. Built by Deutsche Philips of Hamburg, it was displayed in two adjacent booths (right), which presented what the company conceived as the "normal" phone conversation of the future.

Each booth was equipped with a built-in, automatic TV camera focused on the speaker. Each of the "receivers" had two screens, which showed both parties as they appeared on the phone.

Another development, introduced by Nederlandse Industrie Radio Artikelen, Emmen, Holland, is the "Tele-Tracer." This is a paging device for hospitals, offices, factories and other such enclosed areas. Essentially a short-range transmitter and receiver combination, the "Tele-Tracer" consists of a console (right) with 27 keys, each of which activates a different receiver. The receivers are each about the size of a cigarette package (below) and are carried in the pocket. When the key sending to a specific receiver is depressed, the receiver signals with a low buzz, indicating to the person carrying it that he is being paged (below, right). Each receiver weighs only five ounces, and uses transistors so that the batteries will have a long life.

This system is particularly suitable for doctors, who would be relieved of the necessity of watching for light or bell signals and the disturbance of p.a. paging. A special cabinet holds the receivers when they are not in use. Each receiver rests in a numbered slot. When the slot is empty, it is an indication to the signaler that the person assigned to that number is in the building and may be signaled; when the receiver is there, the person is out.
An Extra "Hand" Comes in Handy for Soldering

While the gun is doubtless one of the most popular types of soldering instruments, it has one big drawback—one hand must be used to hold the trigger. But on some jobs you need both hands. What to do? Build a triggering bracket for your gun and gain an extra hand.

Bend a thin copper strip, ½" wide, around the grip and the trigger. About a half-inch should extend in back of the grip. Then solder the two ends of the strip to a ½" nut. The bracket can now be slipped in place and a bolt a quarter- or a half-inch long screwed into the nut. As the bolt is tightened, its base pushes against the back of the grip and tightens the band around the trigger. (See photo above right). Adjustment of the bolt will give either a high or low heat position; a bolt with a knurled head makes adjustment easier. And if you don't have a copper strip, you can use a similar strip from a can. Finally, take a 6" piece of 2 x 4 and notch it to fit the contour of the gun. This will hold the gun in place and you can use both hands for soldering.

One note of caution. Soldering guns are not designed for continuous operation. Therefore, the gun should not be left on for excessive periods of time. When it has been in use for a long enough time, you can easily slip the band off by loosening the nut. Good soldering practice is to keep the trigger depressed only long enough to make the connection, usually not over two minutes. Keeping it pulled longer than that may burn out the gun.

—Wayne Crawford

Old Gooseneck Lamp Makes Adjustable Mike Stand

Instead of getting a perpetual crick in the neck when you're on 'phone, make an adjustable stand for your mike and DX in comfort. It's simple, and costs pennies.

Scrounge around for an old gooseneck lamp—the type with a flexible neck—and remove the socket and wiring. If it doesn't just screw off, you may have to use a hacksaw. Then remove the hardware from an Amphenol 75-PC1M chassis unit and drive the unit into the top of the gooseneck. The diameter of the threaded shank may have to be reduced a bit with a file before you drive it in. Use a block of wood between the chassis unit and the hammer head to prevent mashing the head threads when you drive it.

If your mike is the type that feeds the mike connection through the mounting socket, you will first have to solder the center conductor of the mike cable to the eyelet in the chassis unit. Then feed the cable through the gooseneck and out through the base of the old lamp. The shielded sleeve of the mike cable can be soldered directly to the metal base of the lamp, since the metal gooseneck completes the circuit and provides shielding. If you have a lamp whose neck is provided with ½" pipe thread as connection for the socket, the mounting is simplified. Just connect the two with pipe coupling, and you've got your mike stand.

—Carl Dunant
Do You Have a Buzz

A RASPING NOISE accompanied the horizontal bars that cut the TV picture to ribbons. Having just settled down to catch the fights, I wasn't very happy when the interference—although intermittent—continued.

Giving up in disgust, I turned the sound down. Only then could I hear a faint whirring noise from somewhere in the house.

"Your motor's showing," I stated bluntly upon confronting my wife at her sewing machine.

Unperturbed, she finished the seam. "I'm sorry, dear," she replied. "This dress just has to be finished tonight." Examining the seam intently, she added: "Now you know what the rest of the family puts up with when you're working in the basement!"

She was referring to the combination shop and rumpus room I'm trying to build down there. The project hasn't been too popular with the family since I can only work at it in the evenings. My portable electric saw really bugs up the TV picture.

Knowing that she was bound to have the last word, I decided to see if my neighbor, Sam Egan, could help. An electronic technician by trade and hobby, Sam usually had an answer for my electrical problems.

I found Sam occupied with a repair project in his combination shop and garage.

"Are they selling do-it-yourself appliance kits now?" I quipped. A jumble of electric mixer parts, like fugitives from a junk box, covered the bench before him.

"No such luck," Sam replied. Jerking a thumb at the little motor on the bench, he explained: "I'm tired of putting up with the interference this mixer causes. Just about the time I'm trying to pick up something on my receiver, the kids decide to mix a malt or something."

"Know just what you mean," I sympathized. "But why tear down the mixer? I was hoping you could help me out with a plug-in filter for that sort of thing."

"Can do," agreed Sam. "But in a case like this a dirty commutator makes the job just that much harder for a filter."

I watched with eagle eye while he cleaned the commutator and brushes with carbon tetrachloride. "Brush-type motors are the worst offender when it comes to causing interference," he explained. "A dirty commutator aggravates the slight arcing inherent in these motors." Selecting a piece of fine sandpaper, he began polishing the commutator.

"Why sandpaper?" I asked. "Wouldn't emery cloth do a quicker job?"

"Sure—it would—and ruin your motor in
the process. Emery grains are conductors, and they may short the commutator.

"Poor electrical contact at the commutator," he continued, "causes variations in current flow through the motor. This in turn creates sharp electrical surges that travel through the household wiring system. The result is a lot of hash in radio reception."

"Then putting a motor in top shape is the first step in tackling a motor interference problem," I mused.

"It helps," Sam admitted. "But it doesn't always eliminate the need for a filter. Of course, not every motor causes interference," he hastened to add.

Sam sketched a circuit on a scratch pad and handed it to me. "There's a basic filter circuit," he stated. "It's small enough so that the capacitors can usually be installed right in the motor housing."

Studying the circuit, I mused: "Looks simple enough. How about lending me some junk box capacitors so I can try it on my power saw?"

Sam shook his head. "Nope," he answered, "but I'll give you new ones."

"What's wrong with used ones?" I protested. "Afraid they aren't accurate enough?"

"You never know when an old capacitor might short," he advised. "No use in risking a burn out or shock hazard because of a questionable capacitor."

Digging through his stock of parts for new capacitors, Sam continued: "Capacity values aren't critical. Sometimes it's necessary to try different ones before hitting the right combination. Severe interference problems may require capacities as high as one microfarad."

He pointed to the voltage rating on a capacitor. "Working voltage is the important thing. The higher the voltage rating, the greater the safety factor. Capacitors selected for filters should have a rating of at least 600 volts."

"How about plug-in filters?" I asked.

"Commercial plug-in filters (left) reduce interference from electric razors and small appliances, but almost as effective is a 0.1-µfd capacitor wired across terminals of small motor (above). Filtering action is most efficient if capacitor can be put in appliance housing."

Place filter in housing of tool, if possible, and insulate with spaghetti (left). Third (ground) wire must be connected to ground as below. For appliances without ground wire, connect C2 to frame (bottom drawing). Check with neon tester from housing to ground to make sure a.c. plug is polarized for shockless operation. Reverse plug if lamp lights."

POPULAR ELECTRONICS
A choke will help stubborn cases of power line interference (above.) Wind the inductor on a ⅜"-diameter dowel or spool (multiple- or single-layer winding may be used) and put it with the capacitors in a grounded metal box.

"You know, the kind that plug into the wall outlet."

"They may tame mild cases of interference. But signals generated by a motor can be radiated by the power cord, too. Filtering interference at its source is the most effective method."

The side door banged as Jim Nelson popped into the garage. Jim, a teen-ager interested in electronics instead of hot rods, spent all the time he could hanging around Sam's shop.

"My ham rig's been restricted," he announced..., at least while the family's watching the evening programs!"

"Interference, no doubt," remarked Sam. "Thought you had your transmitter pretty well shielded."

"It is," agreed Jim. "That's what has me stumped. It doesn't bother the neighbor's radio or TV."

"How about the power line to your trans-
Bathtub capacitors provide filter with ready-made shield (right). Connected across the low-voltage terminals of a toy train transformer (right and below), they will cut interference in radios and television sets while the children are playing with their electric trains at Christmas time. These capacitors also simplify installation when there is no room inside the appliance housing.

"The important thing is to shield the filter," Sam explained. "It can be mounted in any type of metal box. Even a can will do the trick. Installation depends upon whether it is used at the source of interference or to prevent power line interference from entering a receiver."

"What's the difference?" Jim inquired. "In either case it can only filter out disturbances carried by the power line. Isn't that so?"

Sam nodded. "Installation becomes critical only when eliminating interference at the source. The filter has to be installed as close to the source of interference as possible, and the filter shield must be bonded to the device being filtered."

"Any possibility of shock hazard?" asked Jim.

"That can be minimized by using a .05-mike capacitor to bond the filter shield... which is a good idea if the filter is used with household appliances. The larger ca-

(Continued on page 120)
Tiny Enough to fit into the palm of your hand, this highly stable printed-circuit crystal-controlled oscillator can inject 100-kc. markers into your receiver right up into the 21-mc. band. Due to the printed wiring, construction time is so short that you can start assembly after dinner and have it working before bedtime.

The oscillator is available in kit form, including the board and components, from Petersen Radio Company, 2800 W. Broadway, Council Bluffs, Iowa. Total cost of the project should come to about $8.00. The 100-kc. xtal is extra—but you may have one in the junk box that would do nicely.

Unpack the parts carefully when you receive the kit, and check each component to make certain that it corresponds with the value printed on the circuit board.* Insert the crystal and tube sockets and all other components in their places, sharply bending each pigtail.

Spot-solder each of the leads at the point where it comes through the board and trim it off flush with the board. Don’t

* There is an unmarked capacitor connection between the 220,000-ohm resistor and the OUT terminal. However, this is no problem. After the 470-µfd. capacitor is installed, the only small tubular capacitor left is the unmarked one. All the other markings are clear.

Note that the circuit diagram accompanying the Petersen 100-kc. crystal is not the schematic of the printed circuit.
use extra flux, and try to prevent the flux in the rosin-core solder from running along the surfaces between connections. Solder a color-coded lead about \( \frac{1}{2} \) to 2 feet in length to each of the terminals marked GND, FIL, and 250. Connect a 4" lead to the OUT terminal.

Drill the holes in the cabinet to match the two mounting holes in the printed-circuit board. Drill two extra holes paired off so that two more screws can be inserted to provide a 4-point base on which the case can stand without tipping. Now line up the printed-circuit board in the bottom of the case and drill a \( \frac{1}{2} \)" hole directly over the ceramic trimmer screw. A screwdriver or aligning tool will later go down through this hole for trimmer adjustment. A \( \frac{3}{4} \)" hole is drilled in the center of the top of the case for the binding post.

Two \( \frac{3}{4} \)" spacers under the printed-circuit board hold it clear of the case. Solder the output lead to the lug on the binding post. Drill and grommet a \( \frac{3}{4} \)" hole about 1" from the edge of a side-plate and pull the three color-coded power leads through. Install the crystal and tube and screw down both side-plates.

**The oscillator** is designed to operate from your communications receiver's auxiliary power output socket. But because the oscillator is wired for a common ground and filament, you must determine which of the following hookups is found in your receiver.

1. If one leg of the heater of each tube in your receiver is grounded, no changes are necessary. Connect the power leads as shown in Fig. 1. Any B-plus voltage from 150 to 250 volts will do.

2. The hookup in Fig. 2 is suggested for the following conditions: receivers which are designed for a.c./d.c. operation; receivers in which the center-tap of the 6.3-volt transformer is grounded; and receivers in which there is no ground in the filament circuit. Note that a separate, small, inexpensive 6.3-volt heater transformer (such as the Stancor Type P-8190) is required for proper operation.

**Connect** the 100-kc. calibrator to the receiver power supply and couple the output terminal to the antenna post. Then turn on your receiver and tune it to WWV (2.5 mc., 5.0 mc., 10.0 mc., 15.0 mc.). Listen for “ticks” separated by precise 1-second intervals.

With your BFO off, you should be able to hear a beat-note between the harmonic of the 100-kc. oscillator and the WWV signal. Using an aligning tool or plastic-handled screwdriver through the grommeted hole at the top of the case, carefully rotate the trimmer until exact zero beat is obtained. You may now be quite confident that the injected 100-kc. markers are right on the nose!
The Mysterious EEG—And You

Every time she thinks—and even when she doesn't—those wires coming out of the lady's head (above) record her brain wave pattern. Although the car's standing still, she's "driving" down a busy highway. The purpose of the "trip" is to test driver alertness on the "EEG" (electroencephalograph) parked next to the car.

The "EEG" is a device which graphs electrical impulses from the brain. Also recorded are pulse action and the tendency to perspire. From this data, reaction time can be learned. In tests made by Chrysler engineers, the subject turns the steering wheel to keep a moving beam of light in line with a stationary beam on the screen in front of the windshield. Tape recordings of traffic noise and engine sounds played through a speaker in front of the car make the tests as realistic as possible.

An advantage in using the "EEG" to measure driver alertness is that it does not interfere with the driver's natural tendency to become drowsy in long simulated driving tests. Many of the previous methods which were used tended to keep the drivers awake, Chrysler engineers found, and thus defeated their purposes.

The tests show alertness drops after one-and-a-half hours of steady "driving."

Balancing Act

A new electronic unit for balancing auto engines has been developed by General Motors. The Pulse Synchronized Unbalance Indicator (right) detects and corrects unbalance at lower limits than was possible before. At any running speed, PSUI takes the engine's "pulse" so that the unbalance can be corrected both at the flywheel (see photo) or at the fanbelt pulley wheel at the front end. It's done by putting on counterbalance slugs.

December, 1957
Hear That Jingle? There's a Battery in Your Pocket

In these days of rising costs, it's hard to get something for nothing. However, Uncle Sam makes you a present of a free battery every time you change a dollar bill.

Take an ordinary piece of white paper and moisten it with warm salt water. Hold it in place on one side of a silver coin with a rubber band, and you've got a battery powerful enough to drive a small transistor oscillator (see schematic at right) or receiver. Transformer T1 is an Argonne AR-103. The contacts of the coin should be made according to drawing below. Use 2000-ohm headphones.

For best results, the coin should be clean and shiny. The negative end can be held to the wet paper with a rubber band. This type of battery will remain effective as long as the paper is damp.

A dime will deliver 0.5 volt at a load of 50 µa., enough for the oscillator. A quarter will give a bit more voltage at double the current, and a half-dollar will deliver 0.7 volt at 125 µa. Place cells in series for higher voltage.

—William I. Orr

Build a Handy Broadcast-Band Tuner Assembly

You'll find this handy broadcast-band tuner ready for instant action, whether you experiment with germanium diodes, transistors, vacuum tubes, or all three. It consists of a ferrite antenna coil (Lafayette Radio MS-299) center-tapped to match it to the comparatively low impedance of a common-emitter transistor stage and a 365-µfd. variable capacitor. Five Fahnestock clips allow quick connections for antenna, ground, detector or detector/amplifier. (See the schematic and photos below.)

The coil is mounted on a wood base by means of the metal bracket which comes with the coil. Simply bend the bracket at right angles and use two round-head wood screws about ½” long. The capacitor is held by a 1½” x 2” piece of Bakelite or similar material and fastened with screws to the edge of the wood base, as shown in the right-hand photo. A standard or miniature type tuning capacitor can be used.

All wiring is point-to-point. The wire leads are soldered directly to the ends of the clips before the clips are fastened to the base with screws. A midget setscrew knob is fastened to the end of the threaded shaft of the ferrite coil, while a larger knob with a ¼” hole should be mounted on the shaft of the capacitor. The clips can be marked with ink for handy identification.

The base may be of any size you desire, although I found 5” x 2” x ½” very convenient in this case.

—Art Trauffer
Occasionally you find incompatible elements in a home. Aunt Emma's repeated sneezing at Fido or father's allergy rash after mother's last supper surprise can be problems. But we are not expected to do anything about them, except sympathize. However, when the living-room radio kicks up a storm because it can't get along with the kitchen fluorescent fixture—then they turn to us with a "What are you going to do about it?" look in their eye. Well—we can do something about it!

What Is the Noise? It's honest-to-goodness radio interference by big-as-life radio waves—coming from the lamp itself. To add insult to injury, the graph on the next page shows that the "hash" is apt to be concentrated right in the AM broadcast band—where we least want it.

The waves are generated by a very tiny arc which occurs when electrical circuits are made or broken. In the fluorescent lamp, the making and breaking of the mercury arc 120 times each second (double the 60-cycle line frequency) is the cause of all the trouble.

The noise heard is usually one of two types. First of all, there is a sharp crackling noise heard at starting. Crackling is normal, and typical of the noise created by almost any switched circuit; this we can ignore. The second is the steady buzz (or

Some words of wisdom on the cause and cure of fluorescent lamp noise

By Eugene F. Coriell
Lt. Col., USAF
Paths of r.f. noise from lamp to radio or amplifier: 1) direct radiation, 2) a.c. line radiation, and 3) a.c. line conduction of the noise.

Even sometimes a roar heard when the lamp is in operation. The buzz reaches your radio or hi-fi gear in three ways:

1) It can be radiated either directly from the lamp or indirectly by "bounce" from a nearby metal object.
2) It can be radiated from the a.c. line supplying the lamp.
3) It can be conducted along the a.c. line to your equipment power plug.

Direct radiation interference when the radio is over 15 feet away from the light fixture is unusual. However, when the local station is weak or when reradiation is taking place, noise can be a problem over much greater distances. Occasionally, you may even get complaints from your neighbors in the next apartment.

Identify the Source. The first thing to do is to make sure the noise is coming from a fluorescent light and not from some other appliance. Turning off all lamps and other devices and turning them on again one at a time should point out the noisy ones. (Since noise of this type does not generally "add up," locating and eliminat-

The graph at right shows the interference frequency coverage for a 40-watt bulb only. Other sizes manifest different areas of interference. The 72" "Slim-line," for example, has a noise null at the top of the broadcast band and its noise peak at about 5 mc.
ing one source may allow interference from some other device to take center stage.*

Now, that we have located the culprit, should he be eliminated at the source of the crime—the radio, or in his home ground—the fixture? Ideally, interference should be corrected at the source; however, as this is not always the easiest approach, let's try a few of the simpler possibilities.

1. Reverse the power plug of the radio, amplifier or, if possible, the lamp.
2. Remove the bulb and rotate it 180° or swap it end-for-end. Unfortunately, either of these tricks may give only temporary relief.
3. Install a new bulb. Older ones are more likely to be noisy. If a new bulb is not available, try one from another lamp.
4. If either the radio or the lamp can be moved, you might find that even a few feet will make considerable difference.

Radiation or Conduction? From here on in, things are apt to be more time-consuming and possibly more expensive. Let's find out whether the interference is being radiated or conducted. Short out the radio antenna lead to the ground post or chassis. On loop-equipped sets, short out the two loop terminals. In audio gear, remove all input cables from the amplifier or preamplifier (record player, tape recorder, tuner cables) and short-circuit each input to chassis. **

If the noise stops, the interference is probably being radiated. If it continues, it's being conducted along the power line. If the hash is cut down somewhat, radiated interference has probably been masking weaker conducted interference which can be heard now that the radiated variety has been shorted out. When we know the type of noise we are dealing with, we're free to try the remedies below.

Radiated Interference. Having determined that the interference is of the radiated variety, there are various approaches we can try. Any one of them or any combination may prove effective.

1. Shorten the a.c. cord of the affected equipment, thus reducing the antenna action of the cord.
2. Make sure any metal shields provided for GT/G glass-type tubes are installed properly.
3. For sets equipped with a loop antenna, try an outside antenna using a low-capacity shielded lead-in.
4. For hi-fi gear not already connected to an external ground, try bonding each chassis to a water pipe by a heavy wire.*

If you find that the external ground causes more noise than it cures, try removing the bonding wire from one chassis at a time. This will break any ground loop that might result from any two chassis being connected both by the cable shields and the bonding wire. You can also try replacing the first preamp tube (12AX7, 12AT7, 6SC7); if the old one is gassy, it may be rectifying the r.f. "hash" to audibility.**

Conducted Interference. If the shorting test described above does not kill the

(Continued on page 118)

* For quieting electrical appliances in general, see the book "How To Locate And Eliminate Radio And TV Interference," by Fred D. Rowe, published by John Rider.
** A simple phone shorting plug can be constructed by soldering the plug's center pin to its shield.

December, 1957
Radio Japan's transmitting station is at left. Above, a popular song show is broadcast from its Radio and Television Hall. The singer is Miss Chiyoko Shimakura.

Radio Japan's Nazaki transmitting station is at left. Above, a popular song show is broadcast from its Radio and Television Hall. The singer is Miss Chiyoko Shimakura.

Radio Japan is the name of the International Broadcasting Service conducted by the Nippon Hoso Kyokai (NHK), the only public service broadcasting organization in Japan. Its aim is to give the listener a correct picture of the country and an inside view of the current situation in Japan. Programs of news, native and classical music, art, culture, politics, and customs are transmitted to 13 different areas of the world in 15 languages.

Two frequencies are used simultaneously for each of the 13 transmissions. This insures easy reception by listeners in remote parts of the world in relation to Japan. The simultaneous transmissions originate from the Yamata and the Nazaki transmitting stations respectively—the former being equipped with a 50-kw. and a 100-kw. transmitter, and the latter with a 50-kw. transmitter. Upon installation of a 100-kw. unit at the Nazaki station, most—if not all—of the programs of Radio Japan will be switched to the higher power.

The following frequencies are employed according to the four seasons of the year: 6069, 6080, 7180, 7242.5, 9675, 9695, 11,705, 11,725, 11,780, 15,135, 15,225, 15,235, and 17,785 kc. Radio Japan classifies the seasons as Summer (May-Aug.), Winter (Nov.-Feb.), and Equinox (March-April and Sept.-Oct.). Though the change-over of channels is made in full consideration of various conditions, it is kept to a minimum to avoid inconveniencing listeners. Frequencies difficult to receive are being replaced whenever the occasion arises.

Complaints are frequently received from listeners to the effect that the duration of programs is too short. Every effort is being made to rectify this condition and Radio Japan hopes to be able to meet listeners' requirements in the near future. Antenna-wise, they are well equipped, employing the following types: a doublet HFT-100 kw., all-wave type AWW, AWH-50 kw., and rhombics for 50 and 100 kw.

Radio Japan is represented by the call letters "JOA" (Nazaki) and "JOB" (Yamata). Both of the stations are 70 kilometers north of Tokyo and the facilities are owned by the International Telephone and Telegraph Company. The studios are housed in the NHK main building in downtown Tokyo. Programs are sent by land wire to the transmitting stations.

Reports of reception are welcomed from listeners everywhere. The correct address is: Nippon Hoso Kyokai, 2-2, Uchisaiwai-cho, Chiyoda-ku, Tokyo. Verification will be in the form of either a card or a letter.

(Continued on page 126)
THE AVERAGE PERSON thinks of transistors only in connection with miniaturized equipment. There's no technical reason, however, why the other advantages of transistor operation—light weight, ruggedness, low power require-
ments, long service life—can't be extended to the design of "full-sized" equipment. An important step along this line has been taken by the Heath Company (Benton Harbor 20, Mich.) with the introduction of a standard-sized transistorized radio in kit form—the Heathkit Model XR-1 Transistor Receiver.

Designed for use as a "universal" AM receiver, the Model XR-1 serves equally well as a table model set in the home or as a lightweight and rugged portable for use at the beach, on outings or on picnics. Its shock-free design insures complete safety in the kitchen or bathroom, while its ample volume, sensitivity, and tone quality are equivalent to those of a.c. line-operated receivers. As a construction project, the XR-1 will not exceed the ability of the rank beginner, nor be an insult to the more advanced worker.

Putting It Together. The Model XR-1 mounts into an unbreakable plastic case measuring approximately 9" x 8" x 3½". Over-all weight, including batteries, is slightly under five pounds. With a built-in rod type antenna, the XR-1 tunes the entire AM broadcast band using a superheterodyne circuit. There are six transistors and two diodes. The transistor line-up includes a 2N252 converter, a 2N253 first i.f. amplifier, a 2N254 second i.f. amplifier, a 2N238 first audio stage, and a pair of 2N185 transistors in a Class B push-pull audio output stage. One diode serves as a second detector and, in addition, supplies the a.v.c. control signal to the first i.f. amplifier;
the other diode is connected between the converter and first i.f. amplifier stages and provides protection against strong signal overloads. The i.f. value is 455 kc.

A detailed step-by-step instruction manual includes both pictorial and schematic diagrams. In addition, “wall-size” prints of the pictorials are supplied which make the job even easier.

Actual assembly is broken down into more or less independent stages, thus allowing the builder to take an occasional “break” during construction. First, of course, most of the basic chassis hardware is mounted, including terminal strips, transistor sockets, audio and i.f. transformers, and the local oscillator coil.

The circuit wiring is done in stages according to the electrical breakdown of the receiver’s circuit. Thus, following the manual, you’ll wire the stages in this order: audio output; audio driver; then i.f. amplifiers. The r.f. oscillator and antenna circuits are wired as part of the final assembly step.

Assembly time will vary considerably with the individual worker. However, if you like to take things slow and easy, with frequent “breaks,” you still should be able to complete the kit in less than a week, working a couple of hours each night . . . or over a week-end.

Special Features. Heath has taken special steps to make the alignment of the XR-1 as painless and as simple as possible. No r.f. signal generator or other special test equipment is necessary. A plastic alignment tool is furnished as part of the kit. And all coils are pre-adjusted at the factory so that relatively little re-adjustment is needed for peak performance. Chances are you’ll be able to pick up most local stations on your first try.

A 4” x 6” PM loudspeaker easily handles the output of the Class B power amplifier stage. Good tone quality is insured not only by the comparatively large speaker (for a transistor receiver) but by a built-in special baffling arrangement.

One of the most important features is the use of standard flashlight batteries in the receiver’s “power pack” and the long life (500 to 1000 hours) obtained from the batteries under normal operating conditions. Operating power is supplied by a 9-volt power pack, made up of six size “D” flashlight cells.

Your reviewer calculated the cost of operating this receiver, assuming that you pay “list” prices for your batteries (instead of the somewhat lower “net” prices), and compared this cost to that of operating a standard line-operated table model radio receiver. At average electric power rates, it costs no more—if as much—to operate the XR-1 as it does to operate a “conventional” a.c. or a.c./d.c. receiver.

Comment. The XR-1 assembles without difficulty and the test model worked when first turned on. Almost all local stations could be picked up with good volume even before alignment.

Construction could have been made a little easier if one or two modifications were made in the order of assembly. In a few instances, one part interfered some-
"I know what an inductor is—I think—but I'm pretty hazy as to its use in an electronic circuit. And while we're talking about inductors, exactly what's the difference between a solenoid and a toroid, which I understand are two forms of inductors?"

PICTURE a complicated highway interchange with no directional signposts, traffic lights, or highway police, and you have a pretty good idea of what an electrical circuit would be like without "oppositional" components that guide, cajole, and coax electrons to follow prescribed paths. Resistors, capacitors, and inductors—occurring singly or in various combinations—comprise the fundamental oppositional elements that direct electronic traffic so skillfully even in complex circuits.

Ordinary resistors are undiscriminating components; they oppose d.c., a.c., high frequency, and low frequency alike. A given current of any type passing through a specific resistor causes the same voltage drop. Capacitors are different; they oppose changes of voltage in any circuit of which they form a part but do not react significantly to rapid current variations.

Inductors vs. Capacitors. An inductor may be viewed as the exact opposite of a capacitor. Made up of turns of wire in the form of a coil, an inductor opposes current rather than voltage changes, especially when these variations occur at a high frequency. This characteristic makes the inductor a useful complement to the capacitor in a power supply filter circuit.

A full-wave rectifier circuit changes alternating current to pulsating direct current (Fig. 1). This "hill and valley" formation of pulsating d.c. is usually not suited for operating d.c. electronic equipment until the "valleys" are filled in.

Consider the filter circuit shown in Fig. 2. As the pulsation appears across the capacitor C, the latter charges to the peak voltage (points labeled A) of the input wave. When a valley appears (points labeled B), the capacitor attempts to discharge through the inductor L into the load, which may be any device that uses direct current.

Since such a discharge would constitute a sudden surge of current, the opposition that inductor L offers to such an abrupt change forces C to retain most of its charge until the next peak appears to bring it back to full charge again. In this way, L assists C in maintaining the circuit voltage constant, an action necessary to change pulsating current into pure d.c. In this circuit, L is termed a choke.

Opposition Factors. The opposition an inductor or choke presents to varying currents depends upon two factors: (1) how fast the current varies (frequency), and (2) the physical construction of the coil—the number of turns, turn spacing, coil diameter, and kind of core. A filter choke of the type just described has hundreds of turns of fine wire, an iron core, and is said to have a high inductance. Just as

![Fig. 1. Rectifier changes a.c. to pulsating d.c.](image1)

![Fig. 2. Filter smoothes pulsating direct current.](image2)

![Fig. 3. "L" blocks high frequency, "C" passes it.](image3)
resistance is measured in ohms, e.m.f. in volts, and current in amperes, inductance is measured in henrys. The symbol "L" signifies inductance. Smoothing chokes usually run from 10 to 30 henrys.

Any time a circuit condition calls for choking off a rapidly varying current, an inductor of the correct size is needed in conjunction with a properly chosen capacitor. For example, suppose an electron tube is generating a current of high frequency, say 1,000,000 cycles per second (1 mc.). This tube is fed d.c. voltage and current from a power supply, but the high-frequency current is not to be permitted to flow backward through the supply.

Connecting an inductance and capacitor as shown in the partial schematic (Fig. 3) fulfills this requirement by permitting the d.c. to flow through the inductor but opposing the high-frequency current back-flow through the inductor. The capacitor provides an easy path for the high-frequency current to return to the tube—a necessary arrangement to assure a complete circuit for this energy. An inductor like this has relatively few turns wound on a ceramic or plastic core; its inductance might range from 2 to 10 millihenrys (0.002 to 0.01 henry). Because the frequency is so high, not much inductance is needed to place a barrier in front of the incoming varying current.

In summary, an iron core coil of many turns has a high inductance and is especially useful as a choke in low-frequency circuits; high-frequency hookups call for low-inductance coils of few turns on non-magnetic cores.

**Toroids and Solenoids.** Over the years, toroids have been used desultorily by many of the larger overseas communications companies for the special filter applications in which they perform particularly well. The last decade has seen a steady growth in the number of circuits and devices in which toroidally wound coils have come to be preferred over solenoid types.

The word *toroid* describes a method of coil winding—Fig. 4. Turns are placed around a doughnut-shaped core which forms an absolutely closed magnetic circuit as illustrated. A solenoid, on the other hand, is generally defined as a coil fabricated on a straight core, sometimes iron, and other times air or non-magnetic solids like plastics or fiber—see Fig. 5. Certain types of transformers have two separate solenoid coils on a common core.

What is the secret of the toroid's sudden rise to prominence? Known for many years to be vastly superior to solenoids in certain important respects, toroids were avoided by designers and manufacturers for two reasons. Suitable core materials were not available, especially in applications involving the higher audio frequencies and the radio frequencies. And automatic machines for winding turns around a doughnut core were virtually unobtainable at any price.

Neither of these problems exists today. High-speed automatic toroid winders form these inductors just as quickly as solenoids; and modern core materials like Permalloy dust, the ferrites and mu-metal make them practical for use at the higher frequencies.

The "open" magnetic circuit of the solenoid forces its lines of force to travel through the surrounding open space to link with the core at both ends, whereas the "closed" path of the toroid core confines the field to the molecules of the core so that there is little or no external field. Two very significant advantages arise from this behavior: first, it makes possible higher inductances with fewer turns of wire, and second—probably much more important—it does away with the need for carefull shielding. Where there is no external field (Continued on page 118)
Father of Radar Gets His Reward from Patent Office

The U. S. Government finally recognized the daddy of radar by granting a patent to Col. William R. Blair (Ret.), above, right, who conceived the pulse-echo method of direction finding prior to 1930. It was developed during the 1930's at the Signal Corps Laboratories in Fort Monmouth, N. J. In 1937 a prototype, SCR-268, radar system (above, left) was demonstrated for the Secretary of War and Members of Congress. Plans for this set were turned over to manufacturing companies so that they could build radar equipment for the U. S. Army.

Due to the high degree of secrecy surrounding the development of radar, a patent application was not filed by the Army Signal Corps until 1945, and since then the Patent Office has had the matter under consideration. This radar patent is considered to be as important to the military as the first U. S. patent issued on the telephone was to commercial communication.

Scope "Shadow-Screen"

The oscilloscope Shadow-Screen manufactured by Van-Dee Products, Laguna Beach, Calif., is said to end the need for subdued light or an oscilloscope hood. It consists of hundreds of small, hexagonal openings that serve as individual shadow boxes, shutting off glare. The shape of the openings permits observation from any point within 45° of face-on position. Note contrast in photo above.

Open Sesame

Genie Lift-A-Dor (not the luscious lady below, but what she's holding) is a new R/C system for opening garage doors from your car. If you should ever want to put the car away with her around, you'll find that a simple touch of the button she's holding will unlock the door, open it and turn on the garage lights. Another push will close and lock the door, and turn out the lights. Made by Alliance Manufacturing Co., Inc., Alliance, Ohio, the device works on a limited-range low frequency which prevents false activation by stray signals.

December, 1957
Make Those Noisy Tapes

The Splice of Life

By EUGENE GARNES

"THE FACE on the cutting room floor" is an old adage of movie-making that has turned many a dull film into a masterpiece. Like the movie-maker, the tape recorder fan can turn his noisy, stumbling reels into gems by some judicious cutting. It's easy, and you should wind up with a perfect splice, as shown in Fig. 1(A). Figures 1(B), 1(C) and 1(D) show how it shouldn't be done.

All you need is a splicing block ($2 or so), single-edge razor blades, ¾" splicing tape and a good scissors (Fig. 2). Ordinary cellophane tape is not satisfactory as it will creep with age and cause sticking. Stable, pressure-sensitive adhesive is used with professional tape equipment. Be very certain that neither the blade nor the scissors is magnetized, since that can cause an audible thump in playback. A head demagnetizer will also demagnetize tools.

The popular diagonal splice will give a strong, durable junction which should last the life of the tape. This is used to remove fairly large sections. The vertical splice gives a weaker bond, is used when short syllables are to be removed. It is made in the same way but with a vertical slice.

The mechanical segue, which is a smooth "dissolve," akin to the dissolve from one scene to another in the movies, is a form of diagonal splice. It provides a smooth transition point rather than an instantaneous one. With a long diagonal cut, 12" or so, the head begins to contact less and less of one tape's pickup surface, reducing the volume accordingly, and more and more of the other, increasing its volume in the same proportion. Result, a smooth dissolve.

Follow the drawings on the next two pages for perfect results...

Fig. 1. Right (A) and wrong (B, C, D) splicing.

Fig. 2. All you need to make a perfect splice.
The tape is placed plastic (shiny) side up in the splicing block which will grip the tape in any one of a number of ways used by different manufacturers. The tape is then carefully cut with a sharp razor blade by following the diagonal slot milled into the splicer. This should result in a perfect, clean cut. It might be better if you experimented a few times with long scraps of tape to achieve just the right technique, before you start in on your first good tape. If you find your cuts are on the ragged side, check your razor once more. If it’s dull, use another one. Use a quick, one-stroke slice and don’t hesitate in mid-stroke. After you’ve cut your good tape, the section containing the desirable material remains in the block. The section to be deleted is removed. Next, the section of tape to be joined to the first is placed in the block from the opposite end. In exactly the same way, you should then cut this piece. Now you will have the two diagonal cuts of the pieces to be joined facing each other, ready to be spliced. The next step is taping the ends together.

**HOW TO EDIT**

When working closely with material such as interviews, you must be able to jockey the tape back and forth while in contact with the playback head and yet not have the driving mechanism engaged. All professional machines provide this feature. You can get the same result with many home machines by cocking the forward control about halfway between off and “full on.” This is generally impossible with push-button machines, however.

Now let’s assume that we wish to edit an “Ah” from the start of a phrase. We “see-saw” the tape, beginning just ahead of the “Ah!” up to two or three words of the phrase. After doing this a few times, we get the feel of the phrase, with a pretty good idea as to where to make the cut. By jockeying the tape slowly, the individual sounds that make up the words can be recognized and the undesirable sound pinpointed.

If there’s a definite break between the wanted and unwanted sounds, it should be easy to make a clean vertical cut there. However, if the sounds run into each other, as in the case of “Ah, yes!” where there is no perceptible break, we have to jockey the tape slowly to determine where the “Ah” leaves off and the “yes” begins. If it is difficult to locate the exact spot, it may be wise to cut a little on the “Ah” side. Then if that’s not satisfactory on playback, you can peel the tape and cut another 1/16-inch or so, resplice and check again, until you get exactly what you want.

In the above case a diagonal splice is recommended, since it will give a very rapid fade-in. This helps to create an effect not unlike that of the voice, which needs a few microseconds to reach full normal output when starting from a quiet state. In editing excess syllables, of course, the vertical splice must be employed.

When non-professional equipment not designed for editing is used, the playback head may not be visible, making it impossible to do close work. In such a case, place a reference mark on the head cover, directly above the head gap, and work from that.

There are certain limitations. You can edit only single-track tape, or dual track tape where only one track has been recorded. Stereo tape can be spliced provided that it is of the stacked-head type.

The next step is probably the most important in the whole operation. Very carefully adjust the tapes so that the ends butt perfectly. You should get an exact fit, since both were cut in the same groove of the cutting block. If you don’t get a perfect match, you might find that you’re suffering momentary loss of sound or sticking during playback, such as in (B) of Fig. 1, at left. Or if the diagonal cuts are out of line, as in (C), you may get the same poor results. Now cut a piece of splicing tape about two inches long and press the sticky side down directly over the joint with the ball of your thumb. Don’t disturb the alignment of the tapes as you press down. Also, make sure the sides of the splicing tape are parallel to the diagonal cut. With care, press the splicing tape firmly, working away from the center. Now pick up the recording tape by the ends of the splicing tape and place it on a flat surface. Again apply firm pressure over the entire splice area to insure that the tape edges are bonded to the adhesive. Remove the recording tape in the same way, and use scissors to trim off excess splicing tape, cutting slightly into the recording to prevent future sticking on the edge of the tape. Be careful not to cut too far. And try to make the cut as even as possible, so that it doesn’t resemble Fig. 1(D).

December, 1957
Now that you've made your first diagonal splice, you might want to try a mechanical segue. The procedure is essentially the same as in the previous steps. Put the first section of tape on a flat surface, preferably a wooden cutting block. Carefully place a ruler on the tape for the long diagonal cut—a 12" length might be good for your first try. Cut the tape cleanly in one stroke. Then place the second piece of tape in the same position, and measure off the exact same length. This time, however, make the cut in the opposite direction, so that the two cuts match. The next step is shown at right.

Before reaching the ends of the splicing tape, cut off about a half-inch diagonally. This will allow for smooth passage during playback. Complete the application of splicing tape, pressing it out all the way to the ends. When you reach the masking tape supports, it will be safe to remove them, since the already applied splicing tape will offer sufficient support. Make certain, however, that you don't disturb the butt as you pull off the masking tape, or you'll have to begin all over again. Press it down firmly.

Pick up the spliced tape and cautiously trim the excess splicing tape, cutting slightly into the recorded tape. This completes your mechanical segue, which—if properly made according to the preceding steps—will result in a smoothness equal to the most skillful mechanical segues of professional engineers. This method is best for slower tape speeds, 7½ and 3½ ips being ideal. At the latter speed a 12" splice will give a four-second segue, while at the former speed the segue will last for about two seconds.
Among the Novice Hams

By HERB S. BRIER, W9EGQ

IN DISCUSSING the theory behind questions appearing in the FCC amateur license examinations (October and November issues), so far we have made no distinction between direct current (d.c.) and alternating current (a.c.). This is because everything that we have learned up to now is equally true for either type of current. Nevertheless, there are many important differences between the two which must be understood before you can learn much about radio. Anyone who learned how to do long division in school has enough on the ball to master sufficient a.c. and d.c.

I

Figure 1 shows how a.c. peak and effective voltages differ. The part of the sine curve above the base line indicates that the voltage and the current are building up in one direction (positive), and the part below the base line indicates that they are building up in the opposite (negative) direction. The arrow pointing to the right represents the passage of time.

Obviously, if an a.c. generator is connected across a load, such as a light bulb, the current flowing through the load will increase and decrease in step with the voltage. Consequently, maximum power can flow into the load during only a small portion of each cycle. With d.c., however, full

(Continued on page 134)

When Al, KN9IDZ, finishes an operating session, he folds up the desk leaf and closes the door of his built-in wall cabinet, concealing his equipment.
HELP US OBTAIN OUR HAM LICENSES

Prospective amateurs requesting help and encouragement in obtaining their licenses are listed here. To have your name listed, write to Herb S. Brier, W3EQQ, c/o POPULAR ELECTRONICS, 386 Madison Ave., New York 17, N. Y. Please print your name and address clearly. Names are grouped geographically by amateur call areas.

K1/WI CALL AREA

Peter L. Norris (16), Box 167, Strong. Me. (Code and theory)
Richard Bonin, 1039 Main St., Pawtucket, R.I. Phone: PA 3-9834. (Code, theory and selection of equipment)
Ronald Lefebvre (15), 510 Bernon St., Woonsocket, R. I. Phone: FO 9-8858. (Code and theory)
Laurent Ruel, 18 Dearborn Ave., Biddeford, Maine.
Scott Sederquist, 48 Sunset Dr., Beverly, Mass.
David Perrin, 1066 Highland Ave., Needham Heights, Mass. Phone: JUNiper 3-2324. (Code and theory)
Joe Liro (15), 12 Berkshire St., Ludlow, Mass.
Dick Wasta, 12 Joseph St., Terryville, Conn. (Code and selection of equipment)
Roy Gould (13), 7 Thomas St., Maynard, Mass. Phone: TWIN OAKS 7-8174. (Code and theory)
James H. Powell, 76 Nelson St., New Bedford, Mass. (Code and theory)

K2/W2 CALL AREA

Jerry Schwartz, 547 Saratoga Ave., Brookline 12, N. Y. (Code, theory and selection of equipment)
Donald E. Josephs, 30 Meridian Rd., Levittown, N. Y. (Code and theory)
William Wodynski (14), 814 Chase Ave., Lyndhurst, N. J. (Code and theory)
David Luberto, 620 Tenth St., Lyndhurst, N. J. Phone: WE 9-6122. (Code and theory)
Rip Wands (17), 21 Laurel Ave., Tenafly, N. J. Phone: LOWell 9-6527. (Code and theory)
Lewis Lester, 2241 Creston Ave., Bronx 53, N. Y. Phone: FO 5-1294. (Code and selection of equipment)
William Steckman (13), 32-75 44 St., Long Island City 3, N. Y. (Code and theory)
Dick Cunnigham (15), 17 Moore Ave., Pearl River, N. Y. Phone: PE 5-2596. (Code and theory)
Raymond G. Luzi, 1341 Purdy St., Bronx 62, N. Y. (Code)
Howard Messing, 458 Kingsland Ave., Lyndhurst, N. J. Phone: GE 8-6497. (Code and theory)
Daniel Weiner (16), 1340 Wilkins Ave., Bronx 59, N. Y.
James Huss, R.F.D. #1, Eaton, N. Y.
Owen Goldfarb, 330 Blacksmith Rd. W., Leavittown, N. Y.
Martin Belber, 121 Vermilyea Ave., New York 34, N. Y. (Code and theory)
John R. Van Sciver (14), 327 Barclay St., Burlington, N. J. (General Class code and theory)

K3/W3 CALL AREA

Lamar Hecker, 2135 Chestnut St., Hatfield, Pa. Phone: ULYSSES 5-2513. (Code)
David Schade, 2801 Pyramid Ave., Pittsburgh 27, Pa. Phone: TUN 1-0514. (Code and theory)
Lynn Price, R. D. #3, Box 31, Johnstown, Pa.
Tom Newman, Unit 7, Green Hill, Milton Hershey School, Hershey, Pa. (Code and theory)
Robert Myers (14), 672 Davenport St., Middletown, Pa. Phone: FO 2-9624.
Domenick Nardi (14), 1432 So. Clarion St., Philadelphia 47, Pa. Phone: HO 8-4996. (Code and theory)
Anthony Gargano (15), 1320 Dickinson St., Philadelphia 40, Pa. Phone: FULTON 9-9476. (Code and theory)
Fred Hershey (16), P. O. Box 88, Dalmatia, Pa.

K4/W4 CALL AREA

James Burleson (15), Rt. 2, Box 403, Panama City, Fla. Phone: SU 5-4770. (Code and theory)
Morris Sandlin (17), P. O. Box 143, Calera, Ala. (Code and theory)
Ray Linnville, 1106 E. Tunis St., Pensacola, Fla. (Code, theory and selection of equipment)

K5/W5 CALL AREA

Ronald Eddy, Box 8, Waldo, Ark. (Selection of equipment)
Jim Landrecht (14), 1124 Third Ave. N. Texas City, Tex. (Code and theory)
Don Wilder, Box 72, Ruston, La. (Code and theory)
Jeryl Fullen, Box 36, Wister, Okla. Phone: 2547. (Code, theory and regulations)
J. D. Hall, 208 Grace Ave., Ft. Worth, Tex. (Code and theory)
Artie M. Davis (13), Rt. 3, Box 40A, Leesville, La.
Billy Parry (13), 715 So. 12th St., Edinburg, Tex. Phone: DU 2-1186. (Code and theory)

K6/W6 CALL AREA

Joseph G. Fischer (9), 12808 Miranda St., N. Hollywood, Calif. (Code, theory and selection of equipment)
Wayne Claybaugh, 8662 Hoffman, Riverside, Calif. (Theory)
John DuBry (15), 10221 McCleom, Tunun- ga, Calif. (Code and theory)
Dale Shonoy (15), 380 W. Joosquan, San Leandro, Calif. Phone: LO 9-6538. (Code and theory)

K7/W7 CALL AREA

Lynn J. McKell, 244 E. Center, Spanish Fork, Utah. (General class code and theory)
Bill P. Lambing, Rt. 3, Twin Falls, Idaho. (Theory)
Joseph Steely, 977 Wilson Ave., Salt Lake City, Utah. (Code and theory)
Samuel John Reed, 2020 E. Turney Ave., Phoenix, Ariz. (General Class code and theory)

K8/W8 CALL AREA

John Goelz (15), 526 Hedgewood Ave., Zanesville, Ohio. Phone: GL 3-2956. (Code and theory)
Kenneth Wallace, Rt. #2, Waihonding, Ohio. Barry Shaw (13), 5962 Shell Ct., Waterford, Mich. Phone: OR 3-3280. (Code and theory)
Douglas Mark (14), 2209 N. 12th St., Flint 6, Mich. Phone: CEDAR 4-2166. (Code, theory and selection of equipment)
Michael DeFrancisco, 28460 Shamrock Dr., Birmingham, Mich.

K9/W9 CALL AREA

Bill Steffey (13), 599 Lincoln Ave., Glencoe, Ill. (Code and theory)
Robert Wools, 327 E. Georgia St., Brazil, Ind. (Code and theory)

K9/W0 CALL AREA

Bill Condgon, Crane Lake, Minn. (Code and theory)
Michael Sweeney, Lismore, Minn. (Code and theory)
Lawrence D. Harrison, 5532-31 Ave. S., Minneapolis 17, Minn. Phone: FA 2-4977. (Theory)
Peter Backlund, 754 W. Idaho St., St. Paul 13, Minn. Phone: HU 8-4236.

VE AND OTHERS

Noel Denawer, 1311 Fringer Road, San Juan, Trinidad, B. W. I. (Code and theory)
Jerry Zemell, 388 Rusholme Rd., Toronto, Ont., Canada. (Code and theory)

To help prospective amateurs obtain their Novice licenses, the Radio-Electronics-Televi-

sion Manufacturers Association offers a set of code records (recorded at a speed of 331/2 rpm) and a Novice Theory Course for $10.00, post-

paid. The complete course or more information on it is available from RETMA, 1721 DeSales St., N.W., Washington 6, D. C.
Do Your Tapes Sound "Real Pro"?

YOU'VE propped up your tape recorder before the high school band, being careful about mike placement to avoid the tonal fog spread over the bright blare of the brass by the acoustics of the old gym. Or, recording your Wednesday night chamber music group, you monitored for balance between the instruments and for the intimate detail that distinguishes such music. Yet, despite all this care in your recording setup, the tapes somehow don't sound like professional products. Perhaps you accept this lack of quality as inevitable, blaming it on the quality of your small home tape recorder.

The reason for better quality in the professional's end product is not only the equipment utilized but the way he goes about the job, so you might be doing your machine an injustice. Your home tape recorders are capable of far more "professional-sounding" results than you obtained in the past. Devote the same care to your machine that a professional lavishes on his and you may be surprised how closely your taping resembles professional sound.

We won't tell you here how to make a recording. Choice and placement of microphones, acoustic preparation of the recording room, etc., are another story. We are concerned with only one thing: how to assure peak performance of your recorder before you even start to spin the reels.

Pad, Clutch and Tension. The first step is a professional-style pre-recording check of the machine's operation. Take a

By WILLIAM H. O'BRIEN

A little care for your home recorder helps it sound like a studio model
close look at the pressure pad holding the tape against the recording head. If it is not pressing firmly enough against the head, high frequencies will be lost. Pressing too tightly, the tape will slow down. Gently but firmly is the rule. Don’t be afraid to adjust the pad.

Now let’s check the clutch take-up for tension. An overly tight clutch can spoil a recording by “overpowering” the capstan. The clutch starts to pull the tape instead of the capstan, producing noticeable wow and flutter.

Here is a simple test for clutch tension which can be used on most small home tape recorders. Place a pencil against the tape at a point just beyond the capstan. If the tape readily “bows” out, you have correct tension. If not—if the tape skews out of line only by exerting pressure—there is too much tension on the clutch.

The most inexperienced amateur should not hesitate to adjust the clutch. In all likelihood, your home tape recorder has a setscrew or nut to loosen or tighten the

Great improvement in the quality of home recordings can be attained by following the same equipment maintenance routine employed by professional engineers in sound recording studios.

Cleaning the pressure pad of the recorder, the pressure roller and the capstan is a simple remedy for slow-running machines where dirt creates a mechanical hindrance.

feel clutch pad and spring device. Make the necessary adjustment, using the “pencil test.”

“Greasing” the “Skids.” Smooth operation of the clutch, as well as correct tension, is essential for maximum performance of your machine. It’s a good idea to lubricate the felt clutch pad. Remove the part containing the pad from the clutch assembly and saturate it with silicone lubricant. Long Life lubricant is one brand used by professional tape recording engineers. The saturated felt pad should be left out all night; the fluid will evaporate, leaving the silicone behind to form a smooth surface on the pad, reducing fric-
RATION TO A MINIMUM AND ELIMINATING ANY TENDENCY FOR JERKY ACTION.

**Caution:** Under no circumstance use any kind of lubricating oil or similar product (common machine oil) on the clutch, unless the manufacturer of your recorder expressly specifies it for use. The heat produced by the machine in operation causes petroleum products to break down and, instead of lubricating, create friction.

**Clear Heads.** Magnetized heads have a bad habit of erasing the very high frequencies on your recorded tapes. It is a good practice to demagnetize the recording and playback heads of your machine before every use. Head demagnetizers are manufactured by a number of companies and can be purchased for approximately $10. Before using the demagnetizer, cover the pole pieces of the recording head with a double layer of Scotch Brand cellophane tape. This will protect the head from scratches or other damage. The cellophane tape also acts as a "buffer" between the head and the demagnetizing field, helping to maintain even distribution of the field, and enables you to withdraw the demagnetizer in such a way as to assure complete demagnetization. Make two or three passes up and down the length of the pole pieces with the demagnetizer, moving it slowly and steadily and gradually raising it upward and away from the head. Be careful to avoid any abrupt motion, or the head will not be completely demagnetized. It is not necessary to demagnetize the erase head of the machine.

**Smooth Travel.** Correct speed and even tape travel are of primary importance in getting peak performance from your tape recorder. When playing back record-

(Continued on page 112)
**“Bi-Tran”—New Approach to “Pay-Television”**

A completely different approach to “pay-TV” has been revealed to the FCC by Blonder-Tongue Labs., Newark, N. J. The system would double up the existing TV channels—in effect, create new channels—by sending two programs over each one.

As shown at left, each program would consist of two signals—in one case two positives, allowing the picture to be seen, and in the other a positive and a negative, which would cancel each other. The latter would be the “pay” portion. When a viewer wished to see it, a coding signal, coming in over a telephone line, would switch the “pay” signals to positive, and the “free” signals to positive and negative, allowing the “pay” picture to be seen and canceling the “free” one. At the same time, this information would be transmitted back to the telephone exchange, and the toll added to the telephone bill.

In addition to pay-TV, Blonder-Tongue believes that the system would be useful to the Armed Forces for transmitting secret information, and would serve as an aid to educational telecasting.

---

**G. E. Honors Nation’s 150,000 Hams for Public Service**

Nominations are again open for General Electric's annual Edison Amateur Award. Anyone may submit nominations on behalf of radio amateurs who have performed outstanding public service during 1957. Top award will be $500 and a trophy, with runners up getting plaques.

---

**Aircraft “Peeping Tom” Checks on Pilot’s Accuracy**

The Air Research and Development Command has come up with a telemetry method which allows a ground observer to view the action in an airborne single-seat jet interceptor—to “look over the pilot’s shoulder” as it were.

For many years the only accurate method of evaluating a pilot’s performance was to have an instructor watch his actions from a second seat in the aircraft. When the picture on the student pilot’s radarscope is telemetered—by means of a series of high-frequency radio signals—it will be reproduced on a ground scope (see photo at right). The instructor will thus be able—through voice communication—to instruct the pilot from the ground. This telemetry method will also aid the instructor in measuring the pilot’s capabilities.
Tuners are basically temperamental—but a few simple modifications will serve to keep this one "on the nose"

If you own an FM-3 tuner, you can now incorporate in it the design refinements of the FM-3A. A kit of parts for the purpose is available directly from the Heath Company, Benton Harbor, Mich. Designated as the C-FM-3, it contains numerous capacitors, resistors, a new front panel (with dial calibration), an additional pilot lamp and holder, a new dial drive system, and wire and hardware to complete the conversion.

This kit will improve the performance of the FM-3 from several standpoints. The improved mechanical drive results in much easier tuning. Automatic gain control action is made more effective by applying the control voltage to an additional i.f. amplifier stage. The edge-illuminated glass dial enhances the unit's appearance. Parts are provided to stabilize drift, if this has been a problem with your FM-3 tuner. And decoupling components will reduce regeneration and noise.

It is advisable to have the original FM-3 construction manual at hand for reference as you work. It will facilitate the conversion.

Reduce Drift and Hum. A new oscillator trimmer capacitor is supplied as well as a temperature-compensating capacitor to solve your drift problem. If you have no such problem, skip this part of the conversion. Any change in a circuit which is working perfectly may tend to cause trouble rather than make for further improvement. Drift characteristics may be considered normal if warm-up drift time

By Donald L. Stoner
Apply a.g.c. voltage to one additional stage in the i.f. amplifier simply by clipping and moving one wire. This results in more effective automatic gain control action, especially on strong stations.

It's a tight squeeze and a soldering gun comes in handy. Solder the trimmer capacitor securely to prevent mechanical instability.

The modifications are completed with the new parts shown in the photograph at left. But the only change in the external appearance of the unit is the edge-lit dial.

is ten minutes or less. The tuner should be perfectly stable after this period of time.

If tunable hum has been a problem for you, it can be minimized by installing an r.f. filter at the output of the power rectifier. This consists of a 0.001-mfd., 1000-volt disc ceramic capacitor connected between the rectifier cathode (pin 7) and ground.

The final steps of the conversion consist of reorienting the large pulley, installing the new dial plate (a long black plate that provides a new background for the dial), installing a new dial drive shaft, and restringing the dial with a new cord and a white pointer.

Check Alignment. After completing the modifications, check the r.f. alignment. The only adjustment that might be incorrect is the oscillator frequency. With the dial set to the frequency of a known station, adjust the new oscillator trimmer until the station is received properly. The r.f. trimmer can be repositioned for maximum signal strength although it will not be off very far if your receiver was previously aligned.

These simple but worthwhile changes should only take you an hour or two.
BUILD IT YOURSELF in a few hours!

Yes, you build any one of 33 exciting electric brain machines in just a few hours by following the clear-cut, step-by-step directions given in a thrilling booklet! No soldering required ... no wiring beyond your skill! GENIAC is a genuine brain machine—not a toy. The only logic machine kit that not only adds, subtracts, etc., but presents the basic ideas of cybernetics, Boolean algebra, symbolic logic, automation, etc. So simple to construct that even a twelve-year-old can make a machine that will fascinate people with advanced scientific training! With the special circuitry of GENIAC, the Electric Brain Construction kit, you can compose tunes automatically. These new circuits were never available before!

OVER 400 COMPONENTS AND PARTS. Circuits operate on one flashlight battery, and the use of ingeniously designed parts makes building circuits one of the most fascinating jobs you've ever done! You set up problems in a variety of fields—and get your answers quicker than you can set them up! Play games with the machine—nim, tic-tac-toe, etc.—and pit your brain against its logic! Solve puzzles in a few seconds that would take you hours without the aid of the machine. You actually see how computing and problem-solving is analyzed with algebraic solutions transferred directly into circuit diagrams.

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So—mail the coupon for your GENIAC today! Your money back if not delighted!

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  - Part 2—P1B
  - College Physics
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  - Part 2—P2B

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- Algebra
- Solid Geometry
- Calculus
- Statistics

CHEMISTRY
- High School
  - College
  - Analytic
  - Qualitative
  - Quantitative
  - Organic
  - Physical

BIOLOGY
- High School
- Human Biology
- Zoology
- Botany
- Genetics

PSYCHOLOGY
- Normal PS1
  - Child PS2
  - Abnormal PS3
  - Mental Hygiene PS4
  - Aptitude Test PS5
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HEATH COMPANY A subsidiary of Daystrom, Inc. BENTON HARBOR 10, MICH.
HEATHKIT "BASIC RANGE" HIGH FIDELITY SPEAKER SYSTEM KIT

This amazing speaker system can fulfill your present needs and still provide for future expansion. Fine hi-fi performance the result of using high quality speakers in an enclosure especially designed for them. Features two Jensen speakers to cover 50 to 12,000 CPS within ± 5 db. Power rating is 25 watts, and impedance is 16 ohms. Enclosure constructed of veneer-surfaced plywood, ½" thick, and measures 11½" H x 23" W x 11½" D. Precut and predrilled for quick assembly.

Shpg. Wt. 30 lbs. $39.95

HEATHKIT RANGE EXTENDING HIGH FIDELITY SPEAKER SYSTEM KIT

Designed especially for use with SS-1 "Basic" system. Contains 15" woofer and compression-type super tweeter. Extends basic unit to 35-16,000 CPS, 5 db. Impedance 16 ohms. Measures 29" H x 23" W x 17¼" D, and is constructed of ¾" veneer-surfaced plywood.

Model SS-18

Shpg. Wt. 80 lbs. $99.95

HEATHKIT A-9C HIGH FIDELITY AMPLIFIER KIT

This model incorporates its own power supply and preamplifier. Plenty of power with full 20 watt rating. Four separate inputs, selected by panel-mounted switch, and separate bass and treble controls. Ideal for home or PA applications. Output transformer tapped at 4, 8, 16 or 500 ohms. Response within ± 1 db from 20 to 20,000 CPS.

Model A-9C

Shpg. Wt. 23 lbs. $35.50

HEATHKIT HIGH FIDELITY FM TUNER KIT

Now you can have full-fidelity FM performance from 88 to 108 mc at reasonable cost. Features temperature-compensated oscillator—built-in power supply, and beautiful cabinet. Components prealigned at factory.

Model FM-3A

Shpg. Wt. 8 lbs. $25.95

HEATHKIT BROADBAND AM TUNER KIT

Tunes standard AM band from 550 to 1600 kc with fine sensitivity and broadband characteristics. Features include built-in power supply and low-distortion detector. All RF circuits prealigned for simplified construction.

Model BC-1A

Shpg. Wt. 8 lbs. $25.95

HEATHKIT "MASTER CONTROL" HI-FI PREAMPLIFIER KIT

Provides extra amplification, selection of inputs, volume and tone controls, and turnover and rolloff controls, for Williamson-type amplifiers. Beautiful satin-gold enamel cabinet. Derives operating power from amplifier.

Model WA-22

Shpg. Wt. 7 lbs. $19.75

HEATHKIT 25-WATT HIGH FIDELITY AMPLIFIER KIT

Outstanding 25-watt Williamson-type amplifier employs KT66 tubes and Peerless output transformer, tapped at 4, 8, and 16 ohms. A fine amplifier for the "deluxe" system. WA-P2 preamplifier required for operation. Express only.

Model W-5M

Shpg. Wt. 31 lbs. $59.75

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HEATHKIT TRANSISTOR PORTABLE RADIO KIT
A new concept in radio reception! Now you can forget about external electrical connections and have fine radio performance anywhere! Low-drain circuit using regular flashlight cells makes battery operation cheaper than power-line operation of table model sets. Tunes 550 to 1600 kc and features a 4" x 6" speaker for "big-set" tone, six Texas Instrument transistors for fine sensitivity and selectivity, built-in rod-type antenna, and unbreakable molded plastic cabinet in "Holiday" gray. Measures 9" L x 8" H x 3½" D. Appearance and performance are unmatched at this price level. Easy to build! Shpg. Wt. 4 lbs. $34.95

HEATHKIT BROADCAST BAND RADIO KIT
Covers 550 to 1600 kc with good sensitivity and selectivity. Has 5½" PM speaker for good tone quality. Features transformer power supply and built-in antenna. Signal generator recommended for alignment. Cabinet, as shown, available separately. Shpg. Wt. 10 lbs. Model BR-2 $18.95

HEATHKIT CRYSTAL RADIO KIT
Features a sealed germanium diode to eliminate critical "cats whisker" adjustment. Employs two tuning condensers for good selectivity, and covers the broadcast band from 540 to 1600 kc. Requires no external power. Kit price includes headphones. Shpg. Wt. 3 lbs. Model CR-1 $7.95

HEATHKIT ENLARGER TIMER KIT
The dial of this handy timer covers 0 to one minute calibrated in five-second gradations, so that the timing cycle of a photographic enlarger can be electronically controlled. Built-in relay handles up to 350 watts, and enlarger merely plugs into receptacle of front panel. Also provision for plugging in safe-light. An easy-to-build device that makes a fine addition to any dark room. Shpg. Wt 3 lbs. Model EF-1 $11.50

HEATHKIT TABLE-MODEL RADIO
CRYSTAL RADIO
ENLARGER TIMER

NEW

HEATHKIT PORTABLE RADIO

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HEATHKIT FUEL VAPOR DETECTOR KIT
The FD-1 is a safety device to detect fuel vapor in the engine compartment or other sections of your boat. The detector unit mounts in the area to be checked, and the indicating meter and controls mount on the control panel. Will operate intermittently or continuously, and indicates dangers of fire or explosion to protect your boat and its passengers. Models FD-1-6 (6 volts DC) and FD-1-12 (12 volts DC) operate from boat batteries. Kit even includes spare detector unit. $35.95 each

HEATHKIT RF POWER METER KIT
This handy device measures the RF field in the vicinity of a transmitter, whether it be marine, mobile, fixed, etc. Requires no electricity, nor direct connection to the transmitter. Provides a continuing indication of transmitter operation. Merely place it in proximity to the transmitter antenna and it will produce a reading on its 200 ua panel meter when the transmitter is in use. Operates with any transmitter between 100 kc and 250 mc. Includes a sensitivity control for meter. Shpg. Wt. 2 lbs. Model PM-1 $14.95

HEATHKIT TRANSISTOR RADIO DIRECTION-FINDER KIT
The Heathkit Transistor Radio Direction-Finder model DF-1 is a self-contained, self-powered, 6-transistor super heterodyne broadcast radio receiver incorporating a directional loop antenna, indicating meter, and integral speaker. It is designed to serve primarily as an aid to navigation when out of sight of familiar landmarks. It can be used not only aboard yachts, fishing craft, tugs, and other vessels which navigate either out of sight of land or at night, but also for the hunter, hiker, camper, fisherman, aviator, etc. It is powered by a 9-volt battery. (A spare battery is also included with the kit.) The frequency range covers the broadcast band from 540 to 1600 kc and will double as a portable radio. A directional high-Q ferrite antenna is incorporated which is rotated from the front panel to obtain a fix on a station and a 1 ma meter serves as the null and tuning indicator. The controls consist of: tuning, volume and power (on-off), sensitivity, heading indicator (compass rose) and bearing indicator (antenna index). Overall dimensions are 7½” W x 5½” H x 5¼” D. Supplied with slip-in-place mounting brackets, which allow easy removal from ship bulkheads or other similar places. Shpg. Wt. 4 lbs. Model DF-1 $49.95

NEW! Heathkits for the boating enthusiast
HEATHKIT DX-20 CW TRANSMITTER KIT
This Heathkit straight-CW transmitter is one of the most efficient rigs available today. It is ideal for the novice, and even for the advanced-class CW operator. It employs a 6DG6A tube in the 50-watt final amplifier circuit, a 5CL6 oscillator and a 5U4GB rectifier. Single-knob band switching covers 80, 40, 20, 15, 11, and 10 meters. The DX-20 is designed for crystal excitation, but may be excited by an external VFO. Pi network output circuit is employed to match antenna impedances between 50 and 1000 ohms.
Shp. Wt. 18 lbs. $35.95

HEATHKIT GRID DIP METER KIT
An instrument of many uses for the ham, experimenter, or service technician. Useful in locating parasites, neutralizing, determining resonant frequencies, etc. Covers 2 mc to 250 mc with prewound coils. Use to beat against unknown frequencies, or as absorption-type wave meter.
Shp. Wt. 4 lbs. $19.95

HEATHKIT RF SIGNAL GENERATOR KIT
Produces rf signals from 160 kc to 110 mc on fundamentals of five bands, and covers 110 mc to 220 mc on calibrated harmonics. Output may be pure rf, rf modulated at 400 CPS, or audio at 400 CPS. Prewound coils eliminate the need for calibration after completion.
Shp. Wt. 8 lbs. $19.95

HEATHKIT HANDITESTER KIT
Measures AC or DC voltage at 0-10, 30, 300, 1000 and 5000 volts. Direct current ranges are 0-10 ma and 0-100 ma. Ohmmeter ranges are 0-3000 and 0-300,000 ohms. Sensitivity is 1000 ohms/volt. Features small size and rugged construction in sleek black bake-lite case.
Shp. Wt. 3 lbs. $14.95

HEATHKIT ETCHED-CIRCUIT VTVM KIT
Sensitivity and reliability are combined in the V-7A. It features 1% precision resistors, large 41/2" panel meter, and etched circuit board. AC (RMS) and DC voltage ranges are 0-1.5, 5, 15, 50, 150, 500, and 1500. Peak-to-peak AC ranges are 0-4, 14, 40, 140, 400, 1400, and 4000 volts. X1, X10, X100, X1000, X100k, and X1 megohm.
Shp. Wt. 7 lbs. $24.50

HEATHKIT ALL-BAND RADIO KIT
This receiver covers 550 kc to 30 mc in four bands, and is ideal for the short wave listener or beginning amateur. It provides good sensitivity and selectivity, combined with good image rejection. Amateur bands clearly marked on the illuminated dial scale. Employs transformer-type power supply—electrical band spread—antenna trimmer—separate rf and af gain controls—noise limiter and headphone jack. Built-in BFO for CW reception. Cabinet, as shown, available separately.
Shp. Wt. 12 lbs. $29.95 (less cabinet)

HEATHKIT "GENERAL PURPOSE" 5" OSCILLOSCOPE KIT
This oscilloscope sells for less than the previous model, yet incorporates features for improved performance. The OM-2 provides wider vertical frequency response, extended sweep generator coverage, and increased stability. Vertical channel is essentially flat to over 1 mc. Sweep generator functions from 20 CPS to over 150 kc. Amplifiers are push-pull, and modern etched circuits are employed in critical parts of the design. A 5BP1 cathode ray tube is used. The scope features external or internal sweep and sync, 1-volt peak-to-peak reference voltage, three-position attenuated input, and many other "extras."
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TOOLS

and

GADGETS

COLOR-TV ACCESSORY

Checking color-TV sets in the past necessitated turning down each color control separately, making the adjustments, then turning up each color for the proper level of hue and saturation. Or the control grid wires on the cathode-ray tube socket had to be disconnected or shorted to the chassis to make the adjustment. Now, with the PC-120 convergence and purity checker, the socket is simply removed from the color tube and the checker plugged in. By flipping one of three switches, any of the colors may be switched on or off. (Vidaire Electronics Mfg. Corp., Baldwin, N. Y.)

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SLIM DYNAMIC MICROPHONE

- IMPEDANCE: 50,000 and 600 ohms
- FREQUENCY RESPONSE: 70 to 12,000 cps

Use it as a hand or stand mike; instantly detachable, Built-in ON-OFF switch, Swivel bracket fits all standard 3/8"-27 thread floor or desk stand. Bead be adjusted to any position horizontal to vertical. Polar pattern is omni directional. Case finished in black and satin chrome. Really ruggedly built. Overall size: 8" x 1 1/2". With 5 foot cable.

DOUBLE-CARTRIDGE CRYSTAL MICROPHONE

Fully non-directional for PA, recording or communications. Can be tilted toward speaker for directional effect. Uses two crystal units. Freq. range 40 to 10,000 cps. Sensitivity 1/2 minus 54 db. Black painted chrome body. 2,400 ohms. Wired with 5 foot shielded cable.

SPECIAL DELUXE REAR DECK AUTO KIT

Here's everything you need for installing a rear seat speaker in your car. (a) Grill goes with any style speaker cabinet. (b) Switch Kit (c) 6" x 8" RCA made PM auto speaker with Alnico 5 magnet (d) all hardware. Complete instructions.

No. 10 Reg. $28.70 Each $6.95

HIGH QUALITY DOUBLE HEAD SET

Fully adjustable phones, with 600,000 ohm impedance, extra large magnet, removable; spring steel headband, Very light weight—only 4 1/2 oz. Comes with flexible, braided-covered 5 foot cord. A special!

No. 12 Reg. $3.60 Each $1.69

FREE with order of $5.00 or more, high-impedance crystal earphone, 3 ft. cord, standard plug. Flesh-colored. Lists at $1.95 but yours free!

ELECTRONIC EQUIPMENT DISTRIBUTORS, Inc. 3686 El Cajon Blvd., San Diego 4, Cal.
Easy listening — velvet smooth response over the entire audio range—that's what you get in a new Utah Unidrive Coaxial High Fidelity Reproducer. Engineered for exceptionally fine frequency extension of both the bass and extremely high registers—a Unidrive will give you unsurpassed tonal quality—with minimum distortion—a velvet smoothness that is a revelation and a real pleasure to hear.

The Utah Unidrives are unique in design and assembly technique. A single, high efficiency magnet drives two perfectly matched and balanced high and low frequency cones with mechanical crossover, to achieve an efficiency heretofore unattainable in conventional designs. A newly developed skiver roll cone treatment immeasurably increases speaker lifetime.

See and hear the new Utah Unidrives at your dealers today. Available in six models and five sizes—6 X 9", two 8", two 12" and 15". Starting at the unbelievably low price of only $15.95.

"WELCOME LIGHT"

Eighty red and green flashes a minute are produced by this colorful flashing beacon which will guide and welcome guests. It can be hung anywhere. Four multi-color lenses continuously revolve inside a green weatherproof lantern with gold anodized interior. Ten inches high and six inches in diameter, it comes complete with hanging bracket and ready to operate. Price, $29.88, prepaid. (Trippe Mfg. Company, 133 N. Jefferson, Chicago 6, Ill.)

CLAMP-ON AMMETER

Designed to plug into any Triplet Model 310 miniature VOM, the Model 10 adapter converts the VOM to an a.c. clamp-on ammeter for measuring a.c. amperes without cutting or opening current carrying wires. The split transformer yoke opens to fit around a single conductor or busbar when a lever at the side is pressed, and direct readings of a.c. amperes from 6 to 300 in six steps can be made. Price is $14.50 net.

The Model 10 can be used without the Model 310 by means of a No. 311 lead attachment ($1.90 net). A complete package, known as Model 100, is available which consists of the Model 310 VOM, Model 10...
Make Your Career COMMUNICATIONS ELECTRONICS through GRANTHAM SCHOOLS...
PROVEN QUICK TRAINING METHODS

Correspondence training or resident Day and Evening classes are held in Hollywood, California and Washington D.C. by Grantham Schools...one of the outstanding electronic training schools for F.C.C. examinations. Proven...Quick Training Methods...insure students a successful course in training for a position in America's fastest growing industry...

COMMUNICATIONS ELECTRONICS...

Twelve weeks of carefully planned courses enable the beginner to take the Federal Communications Commission examination for a 1st Class commercial (not amateur) license. Ownership of this valuable ticket will provide opportunities for higher pay and more interesting employment in Radio-TV Electronics or in the Commercial Electronics field.

MAIL OR CLASSROOM STUDIES
To better serve our many students and prospective new students throughout America, Grantham Schools of Electronics maintains two complete schools for CORRESPONDENCE or RESIDENT courses...Hollywood, California and Washington D.C. No previous training is required. All courses begin with basic fundamentals.

Here's Proof...

that Grantham Students prepare for F.C.C. examinations in a minimum of time. Here is a list of a few of our recent graduates, the class of license they got, and how long it took them:

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David Steiger, 216 Dowling, Walterboro, S. C. 1st 10
W. D. Mains, 6332 S. Paramount, Rivera, Calif. 1st 12
Paul Schuetz, 1314 20th Ave., Longview, Wn. 1st 10
Robert Todd, 216 West End Ave., Cambridge, Md. 1st 13
Dan Erdece, Station KGVE, Lander, Wyo. 1st 12
Joe C. Davis, Station WABE, Waynesboro, Miss. 1st 11
Paul Churchey, 8674 Weber Rd., Atlinon Ma. 1st 11
H. Reynolds, 257½ Washington Blvd., Venus, Calif. 1st 12

F.C.C.-TYPE EXAMS

Throughout the Grantham Schools courses Federal Communications Commission type tests are used to familiarize students for the actual F.C.C. examination.

OUR GUARANTEE FOR YOUR FUTURE

If you should fail the F.C.C. examination upon completion of our course, WE GUARANTEE to give YOU additional training at NO EXTRA COST. Read full details in our free booklet...become a part of America's future in Communications Electronics.

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Please send me your free booklet, telling how I can get my commercial F.C.C. license quickly. I understand there is no obligation and no salesman will call.

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December, 1957
IF THIS MAN IS ON YOUR CHRISTMAS LIST—

A subscription to Popular Electronics will make a perfect gift for him, and every other electronics hobbyist, experimenter or inventor.

For each month, Popular Electronics offers clearly written, fully illustrated features on building and assembling scores of useful projects, reports on exciting, new electronic miracles which are changing our way of life. There is no more thoughtful Christmas gift, or flattering one, than a subscription to Popular Electronics, the world’s only magazine for hobbyists and experimenters. Each of your gift subscriptions will be announced by an attractive card, inscribed with your name. And what’s more, you can enter or extend your own subscription to Popular Electronics at these special Christmas gift subscription rates, too!

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WRAP UP YOUR CHRISTMAS GIVING NOW! DO IT EASILY, AND APPROPRIATELY, WITH POPULAR ELECTRONICS

POPULAR ELECTRONICS, 64 E. Lake St., Chicago 1, Ill.

clamp-on adapter, No. 311 leads and a Model 101 line separator. Price, $61.90, including a handy durable carrying case. (Triplett Electrical Instrument Co., Bluffton, Ohio.)

TUBE CHECKER KIT

A new tube checker in kit form, the Paco Model T-60 features a free-point selector system, an extra-large 5” acrylic-cased meter, an illuminated, high-speed, brass geared, 3-column roll chart, ripple-finished steel cabinet, and two-color panel with contrasting knobs. It tests all new AM-FM-TV tubes, including series-string types. Dimensions are 10½” x 15¼” x 4½”. Net price, $36.75; matching removable cover extra at $3.95. (Paco Electronics Company, Inc., 70-31 84th St., Glendale 27, L. I., N. Y.)

INTERCHANGEABLE-SCALE METERS

Coverage of more than 100 voltage and current a.c. and d.c. ranges is possible with six custom meters by means of interchangeable scale faces and shunting and multiplier resistors. The rectangular meters come in a sturdy plastic case in 2½”, 3½” and 4½” sizes, and feature d’Arsonval moving coil design, fatigue-tested springs, and stress-released assembled units, within 2% accuracy. Basic meter movements, plus scale
8 reasons why the world's most respected name in communications is **Hallicrafters**

**model S-38D $49.95**
Wonderful starting point for the new amateur or short-wave listener. Same meticulous engineering found in all Hallicrafters equipment—at down to earth prices. Coverage: standard broadcast from 540-1650 kc. plus 3 short wave bands from 1650 kc. to 32 Mc.

**model S-53A $89.95**
Has easy-read overseas dial with international stations indicated. Electrical bandspread and logging scale. Complete with 5 in. speaker, headphone jacks plus phono-jack. Two stages of i.f. Coverage: standard broadcast from 540-1630 kc. plus four SW bands over 2.5—31 and 48—54.5 Mc.

**model S-85, S-86 $119.95**
A superb receiver that pulls them in on 10, 11, 15, 20, 40 and 80 meter amateur bands. Over 1000° calibrated bandspread gives better selectivity on large easy-to-read dial. Features separate tuning condenser and built-in PM 5" speaker. Coverage: Broadcast band 540-1680 kc. plus three S/W bands 1680 kc—34 Mc. S-85 AC, S-86 AC-DC.

**model S-94, S-95 $59.95**
Advanced models that bring in emergency radio, police and fire calls. Newly engineered FM chassis provides low frequency drift and low noise figure. Modern styling with simplified control gives easy operating. Coverage: S-94—30 to 50 Mc; S-95—152 to 173 Mc.

**model SX-99 $149.95**
The best at its price with all features demanded by DX enthusiast. Has "S" meter, separate bandspread tuning condenser, crystal filter and antenna trimmer. Easy-read dial has over 1000° calibrated bandspread through 10, 11, 15, 20, 40, and 80 meter amateur bands. Coverage: standard broadcast 540-1680 kc. plus three Short-Wave bands 1680 kc-34 Mc.

**model S-102, S-106 $59.95**
The only inexpensive complete receivers for 2 and 6 meter bands. New models with all of Hallicrafters famous engineering. Have 7 tubes with rectifiers, built-in 5" PM speaker, low frequency drift, compact bandspread design, phone jacks. Coverage: S-102—143 to 149 Mc. in 2 meter band; S-106 —49 to 55 Mc. in 6 meter band.

**model SX-104, SX-105 $89.95**
Two new high frequency crystal controlled/tunable receivers at low cost. First time available on single band receiver. Ideal for monitoring government marine, fire, police and other emergency frequencies. Coverage: SX-104—30 to 50 Mc.; SX-105—152 to 173 Mc.

THE NEW ONE
THAT'S ON THE DRAWING BOARD TODAY!
Available with convenient terms from your Radio Parts Distributor

Export Sales: International Operations,
Raytheon Manufacturing Co., Waltham, Massachusetts

Hallicrafters
CHICAGO 24, ILLINOIS

December, 1957
the Most Popular
NOVICE TRANSMITTER IN THE COUNTRY!
From "the World's Largest Distributor of Amateur Radio Equip!"

Globe Chief 90
A completely bandswitching, 90 watt transmitter for 10-160M.
Here's a compact, 8x14x8", sturdy rig with well-filtered, built-in power supply. Pi-network matches most antennas from 52-600 ohms. Modified grid-block keying is employed for maximum safety. Has provisions for VFO input and operation. Kit form includes complete manual and all tubes and parts. Meter and cabinet carefully shielded for reduction of unwanted TVI.

AND WRL'S TRIED AND TESTED...

Globe Scout 680
65 watts CW; 50 watts on phone, plate modulated.
A compact, self-contained, bandswitching transmitter for operation of the 6 through 80 meter bands, with built-in power supply. High level modulation is maintained. TVI-suppressed cabinet. Pi-network output on 10-80M; link-coupled on 6M, matching into low impedance beams. New type, shielded meter. Globe Scout 66 is identical, except band-switching 10-160M. Size: 8x14x8".

PRINTED CIRCUIT SCREEN MODULATOR
Designed to permit radio-telephone operation with the Chief and similar CW Xmitter. Soft contained. Kit: $19.95.

FREE 1958 CATALOG!
New 290 page catalog with hundreds of illustrations of over 15,000 quality items from the nation's leading manufacturers. Everything for the ham, hi-fi enthusiast, experimenter and serviceman. Send for your copy today!

faces and multiplier and shunting resistors, are available through local electronic parts distributors. (Precise Development Corp., Oceanside, N. Y.)

"CUSHION-GRIP" SCREWDRIVERS
These screwdrivers will never hurt your hand, according to the manufacturer, no matter how hard you grip them. The resilient "Cushion Grip"—made of neoprene rubber permanently bonded to a tough Amberlite handle—is unaffected by water, oil and gasoline, and will not slip. Torque is 50% greater than that of ordinary plastic or wood-handled screwdrivers.

"Cushion-Grip" screwdrivers are available in four styles and in 16 sizes from 3" to 12". List prices range from $1.00 to $2.70 each. (Bridgeport Hardware Manufacturing Corp., Bridgeport, Conn.)

PLASTIC LAMINATING KIT
With the Photo-Seal plastic laminating kit, you can permanently seal your wallet-size pictures, ID cards, etc., in clear plastic. You just place a photo between two plastic sheets with a polish plate on top and bottom, heat and cool under pressure, then remove and trim. The kit includes a 4" x 5" electric sealing press with a 300-watt, 115-volt heater, two Nickeloid polish plates, and 50 sheets of plastic. Price, $14.95. (Therm Appliance Mfg. Co., Inc., 612 S. First St., St. Charles, Ill.)
THE DILEMMA OF GIANT MOLECULES

Solution: 2 plus 2 equals 5

Polyethylene is used to protect thousands of miles of telephone cables. It is tough, light and long lasting. Its strength lies in its giant molecules—a thousand times bigger, for example, than those of its brittle chemical cousin, paraffin wax.

But polyethylene has a powerful enemy: oxidation, energized by light and heat, shatters its huge molecules to pieces. This enemy had to be conquered if polyethylene was to meet the rigorous demands of cable sheathing. Paradoxically, it was done by making the whole better than the sum of its parts—just as though 2 plus 2 could be made to add up to 5.

To check the ravages of light, Bell Laborato ries chemists devised the simple yet highly effective remedy of adding a tiny dose of carbon black. Then antioxidants, such as those commonly used to protect rubber, were added to check attack by heat. But here the chemists encountered a dilemma: although the carbon black protected against the effects of light, it critically weakened the effectiveness of the antioxidants.

To solve this dilemma, Bell Labs chemists developed entirely new types of antioxidants—compounds not weakened by carbon black but which, intriguingly, are very much more effective when carbon black is present. The new antioxidants, plus carbon black, in partnership, provide long-lasting cable sheath—an other example of how research at Bell Telephone Laboratories works to improve telephone service.
LAFAYETTE MASTER AUDIO CONTROL CENTER with BINAURAL CHANNEL AND DUAL VOLUME CONTROL.

This is not only the finest hi-fi preamp characterized by unmatched features, but it has been functionally designed to keep pace with the conversion of your present hi-fi system to binaural (stereophonic) sound. Incorporates an extra channel and dual volume control for binaural reproduction. Features include DC on all tube filaments, negative feedback in every stage, dual cathode follower output stages and latest printed circuit construction. Less than 0.07% IM distortion and less than 0.07 db harmonic distortion at 1V. Hum and noise level better than 80 db below 3V. Uniformly flat frequency response over entire audible spectrum. 7 inputs for every type of phone, tuner or tape. Tasteful styling, brilliantly executed. Size 12 1/2" x 9 1/4" x 3 3/4". Shpg. wt., 10 lbs.

KT-300—Lafayette Master Audio Control Kit Complete with case and detailed assembly instructions. Net 39.50
LT-30—Same as above completely wired and tested with case and instruction manual. Net 59.50

DELUXE 70 WATT BASIC AMPLIFIER

Here's ultra-stability in a 70 watt basic power amplifier employing highest quality components conservatively rated to insure performance and long life. Features matched pair KT 88's and wire range linear output transformer, variable damping control, meter for bias and balance and gold finished baffle. Frequency response 10-100,000 cps ± 1 db. Hum and noise 90 db below full output. 1M distortion less than 1 1/2% at 70 watts, less than 0.3% below 30 watts. Harmonic distortion less than 2% at 75 watts from 20 to 70 watts. Output impedance 4.8 and 16 ohms. Handsome decorative case perforated for proper ventilation. Size 14 1/2 x 10 x 7 7/8" including cap and knobs. Shpg. wt., 40 lbs.

KT-400—Lafayette 70 watt Deluxe Basic Amplifier Kit complete with case and detailed assembly instructions. Net 69.50
LA-70—Same as above completely wired and tested with case and instruction manual. Net 94.50

LAFAYETTE 12 WATT AMPLIFIER WITH CASE

Complete 12 Watt Power Amplifier with Built-In Preamplifier-Equalizer Brings Real Hi-Fi at Low Cost The Lafayette LA-22 amplifier features wide range frequency response and low hum and distortion. Utilizes premium quality EL84 tubes in a pentode connected balanced output circuit. Five inputs provided for every type of phone cartridge, tuner, tape head, TV, crystal phone, etc. Function selector switch gives instant choice of proper equalization for all types of records and tape head. Loudness control approximates Fletcher-Mason low characteristics for tonal balance at listening levels. Bass and treble controls afford wide variation of cut or boost of highs and lows. Frequency response 30-20,000 cps ± 1 db. Sensitivity, full output 1/2 V on tuner, crystal or aux., 8 mV for magnetic phonograph or tape head. I.M. Distortion less than 1 1/2%. Attactively finished to harmonize with both modern and traditional decor, its appearance matches the Lafayette LT-25 tuner. Size 13 1/2" x 6 1/2" x 4 1/2". Shpg. wt., 15 lbs.

LA-22 Amplifier, Complete With Removable Case. Net 33.50

LAFAYETTE HI-FI FM-AM TUNER WITH CASE

• Armstrong Circuit With Limiter • Foster-Seeley Discriminator • Temperature Compensation and AFC • Custom Styled

Like its matching amplifier, the Lafayette LT-25 FM-AM tuner is a most unusual value with outstanding specifications and superlative performance. Circuit features temperature compensation for stability and low drift, AFC to "lock-in" the station and AFC defect for precision tuning of weak stations. inertia flywheel makes tuning smooth. High selectivity and sensitivity. Meets FCC requirements for radiation. Distortion less than 1% on FM and AM. Frequency Response 20-20,000 cps ± 1 db on FM; 20-5000 cps ± 3 db on AM. Hum level 60 db below 100% modulation. Attactively finished to match the LA-22 amplifier. Comes complete with removable cover, with provisions for mounting either in cabinet or on panel. Size 13 1/2" x 3/16" x 2 3/4". Shpg. wt., 15 lbs.

LT-25 FM-AM Tuner, Complete With Case Net 49.50

100 SIXTH AVE. NEW YORK, N. Y.
\include{postage with order}
at prices everyone can afford.

LAFAYETTE MATCHED HIGH-FIDELITY PHONO SYSTEM

NOBODY BUT LAFAYETTE can bring you a phono system of this quality — and at this price. Indeed a Lafayette "best buy" system designed around the new Lafayette LA-69 20 watt amplifier. The performance of this phono system surpasses the most critical requirements of music lovers at a price below that of commercial phonographs. Twenty-four combinations of record equalization provide an almost endless variety of tone compensation to match varying recording characteristics. In addition to the LA-69 this system includes the famous Gerrard RC-121 4-speed Record Changer featuring full automatic and manual positions and Simple-mix operation; the new improved VRII Variable Reluctance GE Triple Play Turnover Cartridge Model 4G-052 with genuine GE diamond and sapphire stylt, and the celebrated Lafayette SK-58 12" Coastal Hi-Fi Speaker. All units are supplied with plugs, jacks and prepared color-coded interconnecting cables for quick easy installation. For 110-125 volt, 60 cycle AC. Shpg. wt., 50 lbs.

SALE! 119.50

HF-179—Complete Phone System............................................................................................................ Net 119.50

Lafayette Introduces Hi-Fi "Music Mates" Style Matched Tuner and Amplifier

The Lafayette Music-Mates have all of the features required of a fine high-fidelity system. Brilliantly engineered, beautifully styled and moderately priced, the Music-Mates are matched in performance, decor and size. Units are finished in attractive dark maroon and gold. Size 13½" W x 3½" D x 4-3/16" H.

MUSIC-MATE 15 WATT AMPLIFIER

This deluxe amplifier utilizes new premium quality EL84 tubes in push-pull. Distortion less than 0.1%. Frequency response 20-20,000 CPS ± .5db. Has separate bass, treble and volume controls, plus loudness control. 5 input channels with tape and record equalization. Noise minimized by hum adjustment control and rumble filter switch. For use on shelf or custom mounting.

Lafayette LA-41 Amplifier (Less Cage).................................................................................................. Net 48.50
Lafayette LA-40 Amplifier (With Cage)................................................................................................. Net 46.50

MUSIC-MATE DELUXE FM-AM TUNER

A sensitive, selective, stable FM-AM tuner. Temperature compensated oscillator and AFC action assure freedom from drift and "locking-in" of a program. Armstrong circuit with Foster-Seeley discriminator employs 6 tubes plus matched pair crystal diodes plus rectifier. Superior hum and distortion specifications assure excellent reception. AFC defeat for tuning in weak stations. Built-in FM and AM antennas. For use on shelf or custom mounting.

Lafayette LT-41 FM-AM Tuner (Less Cage)......................................................................................... Net 64.50
Lafayette LT-40 FM-AM Tuner (With Cage)......................................................................................... Net 67.50

TRANSCRIPTION-TYPE MANUAL PLAYER

PK-160 with TONE ARM and TWO PLUG-IN HEADS

• MAGNETIC BRAKE FOR FINE ADJUSTMENT OF EACH SPEED
• 4-POLE, HEAVY DUTY TRANSCRIPTION-TYPE MOTOR
• STYLUS WEIGHT ADJUSTMENT SCREW ON TONE ARM
• ACCOMMODATES ALL POPULAR CARTRIDGES

All the important features of professional transcription players have been incorporated in this precision turntable. Extremely smooth and quiet heavy duty 4-pole motor plays 78, 45 and 33 1/3 RPM records. Exclusive magnetic brake, controlled by knob on base plate, permits instantaneous fine adjustment of each speed. Stroboscope disc included checks speeds. Speed selector safety switch protects mechanism by making it necessary to pass through OFF position when switching from one speed to another. 10½" weighted turntable has rubber traction mat. Mounting plate has pickup rest and ON-OFF switch. Size: 12-1/2" x 14". Requires 2½" clearance below motor board and 3" above. With AC line cord, 2 plug-in heads, output cable, 45 RPM adapter. For 105-120V., 60 cycles AC. Shpg. wt., 12 lbs. (NOTE: For protection in shipping, tone arm is separate. Just fasten to mounting plate.)

PK-160—Less cartridge and base............................................................................................................ Net 25.95
PK-164—Some as above except equipped with new genuine GE VRII Triple Play Magnetic Cartridge with diamond-sapphire cartridge....................................................... Net 37.50
PK-162—Wood base for PK-160. Shpg. wt., 5 lbs.............. Net 3.95
PK-163—Unfinished mounting board only. Shpg. wt., 1 lbs................................................................ Net .95

12" VISCOUS DAMPED ARM

16" VISCOUS DAMPED ARM

Reg. Value 158.55

SALE! 119.50

100 SIXTH AVE. NEW YORK, N.Y.

December, 1957
LAFLAYE 6 TRANSISTOR SUPERHET RECEIVER KIT GIVES SUPERB PERFORMANCE... INCOMPARABLE VALUE

- 100% MINIATURE PARTS - NO COMPROMISES!
- LABORATORY DESIGNED - SENSITIVE, SELECTIVE, STABLE!
- CLASS B PUSH-PULL AMPLIFICATION - PLENTY OF POWER!

Lafayette is proud to present its 6 Transistor Superhet Receiver Kit KT-119. This kit represents the epitome of sensitivity, selectivity and stability. You'll be amazed at its superior composite quality! You'll be elated with its superior performance! The electronic circuits use 3 high frequency RF Transistors, 3 dependable audio Transistors and Crystal Diode and features a specially matched set of 3 I.F.'s. Oscillator, High-Q Loop, Class B Push-Pull Audio Amplification, and Transformer Coupling in audio and output stages. Special care has been taken in the design for exact impedance matching throughout to offset maximum transfer of power. Has efficient 2 1/4" speaker, and earphone jack for private listening. Complete with all parts, transformers, push-pull transistors, battery and easy-to-follow step-by-step instructions. 6" x 13/4" x 1 1/8". Shpg. wt., 3 lbs.

KT-119 - Complete Kit - Less Case. Net 29.95
MS-229 - Sturdy, attractive brown leather case with carrying strap for KT-119. Net 2.95
MS-279 - Sensitive matching earphone. Net 2.39

3 TRANSISTOR SUPERHET POCKET RADIO KIT

A remarkable sensitive, super-selective pocket superhet receiver with astonishing performance over the complete broadcast band. Uses 3 high-frequency and one audio transistor plus efficient diode detector and features 2 specially matched RF transformers for maximum power transfer. The components are housed in a professional looking beige plastic case.

The receiver's appearance enhanced by attractive maroon and silver station dial. Sensitive built-in ferrite antenna eliminates need for external antenna. A designer's dream in a true pocket superhet receiver! Complete with all parts, transformers, batteries, case, dial and easy to follow step-by-step instructions. 4¾" x 2" x 1¾". Shpg. wt., 1 lb.

KT-116 - Complete Kit, Less Earphone. Net 16.95
MS-269 - Super Power Dynamic Earphone. Net 3.95

LAFLAYE SIGNAL GENERATOR

COMPLETELY WIRING AND TESTED: ACCURACY AND QUALITY GUARANTEED!

22.50

- FREQUENCY 120KC to 260MC
- 120KC to 120MC ON FUNDAMENTALS!
- 30 DAY TRIAL PERIOD FULL REFUND IF YOU ARE NOT SATISFIED FOR ANY REASON!

Completely wired and tested instrument. Do not confuse with kits sold in the same price range. Has the quality and accuracy of instruments selling for 3 to 4 times as much. Six overlapping ranges - 120KC to 320KC, 320KC to 1000KC, 1MC to 3.2MC, 3.2MC to 11MC, 11MC to 35MC, 37MC to 130MC - all on fundamentals - calibrated harmonics from 120MC to 260MC. Switch between internal modulation at 400 cps or any external source at other frequencies. 400 cps signal can be used separately, Outputs are unmodulated RF, modulated RF and 400 cps audio, RF output is in excess of 10,000 microvolts. Jacks are provided for high or low RF output. Highly stable special circuit design. Fine adjustable RF control, AF output 2-3 volts, input 4 volts, across 1 megohm, 6 inch etched dial plate - protected by clear plastic bezel. Common AF terminals for EXT-MOD input and INT-AF output eliminates need for special connectors. Gray metal case - carrying handle - complete with leads, line cord and plug. For 106-126V, 60-60 cycle A.C. Shpg. wt., 8 lbs.

LSG-10 - Signal Generator. 22.50
Tips and Techniques
(Continued from page 38)
dure. Only three simple steps are neces-
sary prior to installation: (1) pre-cut all
wires to length needed; (2) strip a small
amount of insulation (usually 1/8" to 1/4");
and (3) twist the strands together and
"tin" with solder.

-FINDING FAULTY CAPACITORS-
One of the most troublesome and diffi-
cult-to-locate defects in a radio or ampli-
ifier is the leaky coupling capacitor (A).
An ohmmeter test will usually show
infinite resistance, meaning that the ca-
capacitor is good. Intermittent operation or
distortion occurs, however, because the ca-
capacitor breaks down during operation and
allows high voltage from the plate to the
grid of the following stage.
A sure way to check a capacitor (B) for
an intermittent short is to connect it to a
power supply through a 1-meg. resistor as
shown. If the capacitor is okay, the volt-
age read by the vacuum-tube voltmeter
will be slightly lower than the B+ voltage.
An intermittent capacitor will cause the
reading to rise and fall, while a good
capacitor can be squeezed and leads moved
with no meter reading shift.

-UNTANGLE YOUR LINE CORDS-
Is your test bench a rat's nest of tangled
line cords attached to various instruments?
One solution is to remove the line cord

December, 1957
NEW RECORD CHANGER
ACHIEVES HIGH FIDELITY
TURNTABLE PERFORMANCE

GLASER-STEERS

GS Seventy Seven

offers fully automatic operation
and added record and stylus protection

At last, the quality performance of a turntable has been combined with flawless record handling convenience.
The result is—the new Glaser-Steers GS Seventy Seven.
Wow and flutter are virtually non-existent. Rumble, for all practical purposes, has been eliminated, and automatic features such as the amazing "SPEEDMINDER" mark the GS-77 as the most advanced record changer of our time.

"SPEEDMINDER" does your thinking—it prevents you from using the wrong stylus with your records; selects the correct turntable speed... and intermixes and plays 33 and 45 rpm records automatically, without regard to size or sequence.

Another important GS-77 feature is that the turntable pauses during change cycles and doesn't resume motion until next record has come into play position and stylus is in lead-in groove. This eliminates record surface wear caused by grinding action of record dropping on moving disc—a common drawback in other changers.

Other GS-77 features include—CHANGE CYCLE—only 5 seconds—fastest in the field. MOTOR—4-pole induction; dynamically balanced; hum shielded and shock suspended. ARM—acoustically isolated; has vernier adjustment for stylus pressure, and convenient finger lift for manual play, as well as indicator to facilitate location of stylus on groove; variation in stylus pressure between first and tenth record is less than 1 gram. MUTING SWITCH & R/C NETWORK—maintains silence except when record is being played.

IDLER—automatically disengages in "off" position to prevent flat spots. PRE-WIRED for easy installation, replaces most other changers.

The new GS-77 is absolutely jamproof. A single knob controls all automatic and manual speed operations. $59.50 less cartridge and base (base illustrated, $9.60). See and hear the new GS-77 at your local high fidelity dealer, or write for further information. Dept. PE 12

GLASER-STEERS CORPORATION
20 Main Street, Belleville 9, New Jersey


from each instrument and install a recessed male TV cord connector. From then on, when instruments are not in use, the cord can be detached.

—W.F.M.

CLAY "PROBE" REMOVES FILINGS

Has the pole piece of that speaker of yours grown metallic whiskers? You can easily shave away those clinging metal filings that are very apt to get in the voice-

coil gap—with a piece of modeling clay on the end of a pencil. This pencil-clay "probe" also comes in handy for picking up small parts dropped in inaccessible places.

—J.A.C.

HOLES PROLONG PART LIFE

The life of power transformers and other heat-handling components used in radio-electronics gear can be prolonged by drilling a series of 1/4" holes in the chassis around the component. This allows air to flow up through the chassis. The bottom plate, if present, should also be drilled. In some cases the chassis can be raised above its shelf with wooden strips to encourage air flow beneath the bottom plate. The added ventilation will lengthen the life of the component and others nearby.

Be especially careful to clean away all chips that may have fallen between contact points on the underside of the chassis. You can avoid getting metal chips in the tube sockets by covering the sockets with tape.

—J.A.C.
The 1958 Hi-Fi Annual & Audio Handbook is the most authoritative guide to hi-fi construction, maintenance and equipment ... circuits and systems, and the latest high fidelity developments ... compiled by the editors of Radio & TV News. The listing of contents above is only part of the tremendous number of articles and discussions in this giant bargain volume. Plus: more than 20 clear-cut, step-by-step plans for hi-fi projects.

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At newsstands everywhere ................................................. $1

ZIFF-DAVIS PUBLISHING COMPANY, NEW YORK, N. Y.
Do Your Tapes Sound "Real Pro"?

(Continued from page 87)

ings made on the same machine, correct speed is not particularly important. But when playing back tapes recorded on professional equipment which maintained exact speed, a speed variation in your machine will seriously impair fidelity by noticeably changing the pitch of music and voice. To get full enjoyment from the many fine pre-recorded tapes now on the market, you will naturally want to obtain accurate reproduction.

Here's how you can check the speed of your machine the way the professionals do with a timing tape manufactured especially for this purpose. Such tapes display a printed pattern which repeats itself with complete assurance every 15 inches. At 7½ ips, the pattern will appear once every two seconds; at 3½ ips, every four seconds. Count out 56 consecutive 15-inch segments of the timing tape. Then, with a red wax crayon, make a mark at a point three segments in from each end. This leaves 50 segments between the two red marks. Thread up the timing tape, setting the first

WHERE TO GET IT

You can obtain information on the tape recorder accessories mentioned in this article and names of retail suppliers by writing to the following manufacturers:

Head Cleaner
Long Life Fluid Audio Devices, Inc.
EMC Recording Corp. 444 Madison Ave.
806 E. 7th St.
St. Paul 6, Minn.

Tape and Clutch Lubricant
Long Life Fluid EMC Recording Corp.
806 E. 7th St.
St. Paul 6, Minn.

Head Demagnetizers
Ampex Corp. Audio Devices, Inc.
Redwood City, Calif. 444 Madison Ave.

Intl Pacific Recording
860 Vine St.
Los Angeles, Calif.

4"-Hub Tape Reels
EMC Recording Corp. Samuel Candler Enterprises
806 E. 7th St.
St. Paul 6, Minn. 1050 Ponce de Leon Ave., N.E.

These accessories permit the tape recording amateur to give his equipment the same routine maintenance as is employed in professional sound studios.

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December, 1957

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December, 1957

113
Red mark right next to the capstan, and start the machine.

Note the time in seconds that it takes for the second red mark to appear at the capstan. If a machine is running at exactly 7½ ips, it will take 100 seconds; at exactly 3½ ips, 200 seconds. Don’t expect to hit this reading on the nose. If your machine times out at 98 or 102 seconds, it is satisfactory. Most home tape recorders of good quality will be within plus or minus two per cent of the rated speed. If the machine fails within these limits, there’s no problem.

A slow machine probably means that the capstan is slipping. Correct by cleaning the capstan with Long Life cleaning fluid. Once the capstan and rubber pressure roller have been thoroughly cleaned, the machine should speed up to its correct rate. The bottom photo on page 86 shows how to clean the capstan and pressure pad.

A machine consistently running at excessively slow or fast speeds should be returned to the manufacturer.

**Tape Treatment.** All of the major brands of tape will give completely satisfactory results on home tape recording equipment. Just the same, recording tape does need some special attention if you are aiming at maximum performance. Here’s why that’s so.

All magnetic recording tape is manufactured in wide rolls and then slit into ¼ widths, giving it jagged edges. Passing through the machine, these jagged edges cause a build-up of binder and oxide deposit to accumulate on the heads and guides. Like a fine rough abrasive, these particles gradually wear away the laminated metal of the head. The harmful effects aren’t noticeable at once. A single roll of tape will not do any immediate damage, but in time a definite loss of recording quality will result.

Fortunately, it is easy to prevent this type of damage by removing the abrasive particles from the edge of the tape. Saturate a wad of cotton with the same fluid that you used to lubricate the clutch. Squeeze out excess fluid until the cotton is wet but not "drippy." Holding the cotton between your thumb and forefinger, grasp the tape lightly and run its entire length at fast forward or rewind as shown on page 87. When you’ve finished, take a look at the cotton. You’ll be amazed at the amount of oxide and particles that has been removed.

Be sure to rewind the tape after completing this treatment. It is under tension from being wound while under the pressure of your fingers and, if stored in this condition, it will be damaged.

The treatment will also give the tape a

---

**A Box is Not A Musical Instrument!**

No skilled musical instrument maker, including even those in aboriginal tribes, has ever found a rectangular box satisfactory. In spite of this, today’s hi-fi speaker systems proclaim the ultimate in high fidelity, yet they employ nothing more than the most elementary boxes to perform the complicated function of transforming the vibrations of the loudspeaker into sound.

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uniform layer of silicone to reduce friction and promote more intimate contact between head and tape with less noise and tendency to "drop out."

**Tape Thickness and Reel Size.** Two factors often overlooked by the home recordist are tape thickness and reel size. Professional engineers favor tape with the oxide coat on 1-mil backing. Thinner than standard tape (1½-mil backing), it is more compliant and makes closer contact with the head; yet it is not so thin that it will stretch or break, as occasionally happens with the extremely thin ½-mil tapes.

Another problem of recording on either amateur or professional equipment is keeping the ratio between the outside diameter of the reel and the hub diameter at a minimum. If a considerable ratio exists, the difference in tension between a full reel and an almost empty one can cause a speed variation from the beginning to the end of a recording. A special 7-inch reel has been introduced which holds 1200 feet of 1-mil tape and yet has a hub diameter of four inches. With this larger hub, there is little or no danger of distortion on the layers of tape next to the hub, a mishap prevalent with small hubs and the cause of many poor tape recordings. So, before you make your recording, it's a good idea to remove your tape from the original reel and rewind it onto a reel with a 4-inch hub. It is also recommended that you use the same type of reel for take-up.

The maintenance and operational procedures described here require a great deal of time. However, by employing these techniques, you will obtain better, more professional results and derive greater pride and satisfaction from your hobby.

Now, ready—set—roll 'em! —30—

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**New LOW Prices for CBS Power Transistors**

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Stepped-up sales and production made them possible. The savings go to you. Your net prices for the CBS 2N255 and 2N256 are cut in half!

Now radio amateurs and experimenters can build a variety of economical transistorized equipment, fixed or mobile, capable of real power output:

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- Compact mobile p-a system
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Write for Bulletin PA-16, CBS Power Transistor Applications, giving complete details. Or pick it up along with your low-cost 2N255 and 2N256 transistors at your CBS Tube distributor's.

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Pre-amplifier: 10 watts; 12 watts peak.
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Frequency response: flat 5...50 to 20,000 CPS. at 1 watt
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Returnable in seven days for full refund if not satisfied.

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After Class

(Continued from page 77)

surrounding inductors, there can be no electromagnetic coupling to cause unwanted regeneration and oscillation.

In general, toroids may be stacked one on top of the other in the same case without interaction for the reason given above. Their most important use at present is in wave-filters (resonant and non-resonant traps and peaking circuits). They may be made very stable and unresponsive to temperature changes and vibration, and may be designed with very high Q's even at frequencies up to 60 kc. or 70 kc.

Look for toroid transformers to replace solenoid types in many of the forthcoming high-fidelity systems still on the design boards.

Fluorescent Lamp Interference

(Continued from page 73)

interference, the noise is probably being conducted along the a.c. wiring. Try these steps:

(1) Plug the radio or hi-fi rig into an a.c. outlet on a different circuit, to take advantage of a possible noise-weakening effect of the longer wiring path.

(2) Check for open line filter capacitors in the radio or amplifier. The capacitors eliminate some types of line noise (but not others) and are connected from either or both sides of the line to chassis. If no line filter is present, add one from one side of the line to chassis. To avoid the possibility of a nasty shock, keep the value of the capacitor about 0.02 µfd. and use a 600-volt, good-quality component.

Remedies at the Lamp. If we decide to attack the problem at the lamp, it may have to be removed from the ceiling. But first, check the starter. Occasionally, even though the starter operates, its r.f. grounding capacitor may be open. If the starter seems okay, then we've got to open up the "patient."

(1) Check the "innards" of the fixture for loose metal parts and components. Make sure that the lamp assembly itself is well grounded through its mounting or suspension system. And tighten the clamps on the cable or pipes entering the fixture. The mechanical hum or buzz which you may sometimes hear when you are close to the lamp should not be confused with the r.f. interference. The hum is internal vibration of the ballast, and aside from tightening the ballast's mounting bolts, the only practical way to eliminate excessive hum is replacement.

(2) Install one of the metal-cased filter
assemblies designed for mounting in the fixture as shown on page 73 (bottom photo). Such filters are readily available and will often do the job when all else fails. The filter case must be grounded to the fixture frame through the filter mounting flange. And as a last resort for really "rough" cases of radiation—install a copper-mesh screen across the bottom and ends of the lamp reflector. This serves as a shield against bulb radiation and should be grounded to the fixture. The finer the mesh, the better the shielding but, of course, the greater the light loss.

We know that all fluorescent lights do not cause interference. However, a survey of three radio-equipped offices in a skyscraper, for example, showed severe lamp interference in all three rooms. While the simple remedy in each of these cases was a shielded lead-in from a short outside antenna, there are instances where a lot more work is required. But, with a supply of filters, a systematic approach and a little elbow grease—the noise problem can be eliminated!

Do You Have a Buzz . . .

(Continued from page 66)

pacity jobs employed in such cases can present a shock hazard."

"Does this hold true even if the filter is being used at a convenience outlet?" I asked.

Sam shook his head. "No. All you have to do is connect the filter shield to a good, solid ground."

Jim suddenly let out a whoop. "I heard that!" he exclaimed. "What if a capacitor shorts?"

"That's always a possibility," Sam said. "So how about using a fused filter?"

He plucked an extension cord from beneath the bench, displaying the outlet receptacle. "These fused outlets make the job easy," he said. "They provide fuse protection, a good idea for portable power tools, while the metal box provides a filter shield."

Pointing to the polarized receptacle, he continued: "The outlet provides a sure ground when wired to a 3-wire cord. The third wire is the ground lead. It eliminates shock hazard and serves as a filter ground when portable power plugs are plugged into the outlet."

"Hey," I protested. "One thing at a time. All I wanted was a simple little filter for the wife's sewing machine!"

"Sure," came Sam's quick reply, "but you'll find that one filter leads to another before you're finished!"
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December, 1957

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S & H MAIL ORDER

P. O. Box 38, Fresh Meadows Station Flushing, N. Y.

Transistor Topics

(Continued from page 53)

type" oscillator. Base bias is determined by \( R1 \).

In operation, the a.c. voltage developed across the "primary" winding by the oscillator is stepped up by the secondary and used to operate a small (15-watt) fluorescent lamp (A) as a soft "night light," or power an "electric fence" (B) to keep livestock from straying.

Construction of the basic circuit is relatively simple and the wiring is completely non-critical. \( R1 \) is a 22-ohm, 2-watt carbon resistor. \( B1 \) can be any standard medium or large-sized 6-volt battery (such as a Burgess F4P1 or 2F4).

The combination oscillator/step-up transformer (71) is made from a discarded vacuum-tube audio output transformer. The secondary (low-impedance) winding is partially unwound and center-tapped. It is then rewound and becomes the "primary" winding in the oscillator circuit. The original primary winding (high-impedance) then becomes the high-voltage secondary winding, providing the necessary boost.

Code Practice Oscillators. Back in April, we reviewed currently available transistorized superhet receiver kits. As a result, we received quite a number of requests that such "reviews" be a regular feature of the column, so here goes with a review of transistorized code practice oscillators.

Of the various code practice oscillator (CPO) kits now available, the KT-72, offered by Lafayette Radio (165-08 Liberty Ave., Jamaica 33, N. Y.), is the least expensive. Catalog price is $2.99 (plus postage), including both batteries and a standard hand key. This kit assembles on a small piece of perforated Masonite. The oscillator is designed for headphone operation only.

Allied Radio Corporation (100 N. Western Ave., Chicago 80, Ill.), offers a nice CPO which assembles into an attractive black plastic box. It operates from a single penlite cell (included). The kit number is 83Y 239 and the catalog price is $3.95 (plus postage), less hand key and 'phones. This unit is also designed for headphone use only.

WRL Electronics (Council Bluffs, Iowa) offers a CPO with an easy-to-wire etched-circuit wiring board which assembles in a sturdy aluminum case. Two penlite cells (included) power the circuit. WRL's kit sells for $4.95 (plus postage), and is for headphone operation. The hand key and headphones are available as optional accessories.

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Sun Batteries. While a "sun battery" is not, strictly speaking, a transistor item, it is often used in conjunction with transistorized equipment and, therefore, is of interest to Transistor Topics' readers.

The International Rectifier Corporation (1521 East Grand Ave., El Segundo, Calif.), will shortly release a new silicon solar cell with a lower cost per watt than previously available units. For full specifications, price and availability information, write directly to the manufacturer.

Lafayette Radio's latest catalog offers a "Heliodyne" silicon battery at $6.65 (plus postage). A multicell unit, this solar battery will supply up to 2.0 ma. at 3.2 volts in full sunlight. This is ample power for most small one- and two-transistor radio receivers or amplifiers, and is considerably more than that supplied by standard selenium cells of comparable size and cost.

In addition, Lafayette has announced a new two-transistor radio receiver kit, the "Sunflex," designed especially for solar battery operation. It uses a highly efficient reflexed, complementary symmetry circuit which permits two transistors to give the performance of three. Able to operate on standard penlite cells as well as a solar battery, the KT-132 Sunflex receiver kit sells, less earphone and solar battery, for $11.95 (plus postage).

That's all for now, fellows. See you next year.

Lou
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Short-Wave Report

(Continued from page 74)

The following is a resume of the current reports. All times shown are EST and the 24-hour system is used. At the time of compilation, all reports were correct. Station frequencies and/or schedules may change with little or no advance notice.

Argentina—LRA, Buenos Aires, 9690 kc., carries an Eng. newscast at 2325-2340; s/o at 2343. They verify but it takes a long time to receive an answer. (286)

Belgian Congo—OTM, Leopoldville, has moved slightly from 9380 to 9385 kc. and is powerful around 0000-0030 with classical music. (166)

Belgium—Brussels continues to be well heard with its World Fair Radio program on Sat. at 1815-2000 with news, music, and talks in Eng. on 9745 kc. This is parallel to 15,335, 11,850, and 9705 kc., and relayed by Leopoldville (Belgian Congo) on 9655 kc. (61, 279, and 298)

Brazil—PRA8, R. Clube de Pernambuco, Recife, 6015 kc., has been noted at 2115 with classical music. This is the first time it has been reported. (275)

PSH, Agencia Nacional, Rio de Janeiro, is being tuned on 10,220 kc. from 1715 s/on to 1800 s/off with music and native language. This is a hard one to log! (10)

British Guiana—Here are three reports on ZFY, Georgetown.

The 5981-kc. outlet is being noted at 0455-0517; news in Eng. at 0500 is followed by a religious program. (JM)

The 6035-ke. outlet is tuned with very good signals from 0415 daily (from 0440 Sundays) in English. On some days it may suffer QRM from New Caledonia (Radio Noumea) on the same channel. (104)

One of the rarely heard xmt's is on 9440 kc. It was noted recently from 1815 to 2145 s/off with talks and music, interrupted by news of election returns. (275)

Burma—An unidentified station noted on 9543 kc. is believed to be Rangoon. It is heard with "Radio Newsreel" at 1000 followed by a mixture of Eng. language and native music to 1030. Very little is readable and the 11,764-ke. outlet is not even heard. (39)

Dominican Republic—Another station reported for the first time is H11R, Voz de Fundacion, San Cristobal, on 6175 kc. It is heard at 1900-2005 in Spanish; the IS is four gongs. (76)

Ecuador—An unidentified station tuned at 0000-0100 with L. A. music and Spanish anmts on 5586.5 kc. is believed to be HC4BQ, Radiodif. Feliz voz de Simpatia Manabita, Manta. QRM, QRN, and aero stations on the channel make reception difficult. (23)

Egypt—The Egyptian B/C Service, Cairo, is easily heard at 1830-1900 in Portuguese and at 1900-1930 in Spanish to South America on 9720 kc. (104)

The outlets on 17,915 and 17,778 kc. are noted at 1400-1520 in Eng. and French to Europe with usually strong signals being received. (RB, GC)

Ethiopia—Radio Addis Ababa has an Eng.

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The Radio Society of Great Britain has announced a DX Listener's Century Award. This Certificate may be claimed by any person not holding an amateur radio transmitting license who submits evidence that he has received signals from amateur radio stations located in at least 100 countries. The award cost is 7/- ($1.00), and the rules are set out on page 124 of the September 1956 issue of the R.S.G.B. Bulletin. Further inquiries may be addressed to Mr. John Claricoats, G6CL, R.S.G.B., New Ruskin House, Little Russell St., London, WC 1, England.

15,365 kc. They are asking for reports. (RB, NR, 10, 59, 104, 150)

French Equatorial Africa—R. Brazzaville has been found on 11,745 kc. from 1745 to 1755/close with Eng. pgm. annmts and ID in French. QRM was noted from Moscow on 11,740 kc. and Japan on 11,750 kc. When this channel is used, the 5970-kc. outlet is not heard, and vice-versa. (61)

Germany (East)—Radio DDR, Berlin, is heard daily on 9730 kc. at 1730-1800 in English. (289)

Haiti—Radio Commerce, Port-au-Prince, has changed from 9485 kc. to 9545 kc. for 4VC and is scheduled in Eng. on Sundays at 1700-1730. They also have Eng. on Tuesdays, Thursdays, and Fridays on 4VB, 5980 kc., at 2100-2115. (104, 226, 308)

India—Delhi on 15,105 kc. is being heard at session on 9620 and 15,080 kc. at 0500-0600 daily. (WC)

France—The Voice of Free China, Taipei, is heard on 15,235 kc. at 0005-0030 in Eng., followed at 0030 in Cantonese. This broadcast has been noted so far as being on Tuesdays only. (EC)

BED67, Taipei, 15,345 kc., is heard with "The Little Dragon" at 0700-0730 in Eng. Pop records continue to 0805 but the broadcast is often jammed. (23, 59)
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1450-1645 in Eng. to Australia and New Zealand. This test pgm. carries Oriental music and is dual to 11,710 and 17,860 kc. The 11,710-kc. outlet is better at times. (59, 101, 234)

Another Delhi outlet, 15,090 kc., is fair to good at 1445-1545 in Eng. to Europe and England with news, talks, and native Indian music. (61)

Indonesia—Those who have not received a verification from YDF6, Djakarta, 9710 kc., can try a second report after nine months. The reply to that is averaging about two weeks. YDF6 can be tuned at 0600 to Australia and at 0930 to the U.S.A. with news at 0945. (286)

Iran—Radio Teheran, 9680 kc., has Eng at 1500-1530 (news at 1500), dual to 15,100 kc. The 1400 xmsn is in Turkish, Russian, and Arabic. (286)

A late report indicates that the 15,100-kc. xmr has moved to 17,700 kc. and is being noted at 1330-1530. (Ch)

Italy—Romans can be heard on 9575 and 6010 kc. at 2125-2145 to N.A. in Eng. with news and music, and on 15,400 and 11,905 kc. at 1915-1935 in Eng. to N.A. and at 1935-1955 in French to Canada. (Ch, 61, 298)

Jamaica—Voice of Jamaica, Kingston, has been found on 17,493 kc. at 1645-1700. They verified by airmail in eight days. (226)

Japan—Radio Japan has changed from 17,855 kc. to 17,855 kc. and is being well heard generally to Eastern N.A. at 1800-1900. The parallel channel, 15,325 kc., is not heard in many areas. (26, 59, 226, 240)

Jordan—Hashemite Radio, Ramallah, has Eng. on 6060 kc. at 0630-0700 daily. (WC)

Kenya—R. Mombasa, ZHW6, Kisumu, has changed from 4923 kc. to 4965 kc. It was also noted, apparently testing, on 4985 kc. (MW)

Lebanon—Beirut has been noted on 8007 kc. from 1610 with instrumental, and from 1647 with Arabic music. (166)

Liberia—According to a verification, ELWA, Monrovia, transmits as follows: to Ghana and French West Africa at 0145-0415 and 1445-1645 daily and at 0215-0545 and 1445-1815 Sundays only on 4835 kc.; to N.A. at 2000-2130 on 8650 and 21,535 kc. European listeners can also try for ELWA on 710 kc. at 0145-0415 and 1315-1645 daily, and at 0215-0545 and 1145-1815 Sundays only. Another...
December, 1957

xmsn is reported on 15,200 and 21,535 kc. at 1815-1945. (AF, SF, RM, JW, MW, 176)

Malaya—The BBC Far Eastern Station, Singapore, is being heard well on 21,655 kc. from 1100 to 1150/30, relaying programs from BBC, London. It operates dual to 17,890, 13,310, and 9690 kc. The schedule is 0915-1150. (61)

Monaco—3AM3, 6035 kc., and 3AM4, 7140 kc., Monte Carlo, are excellent at 0030 s/on but fade at 0330. All programs during this time are in French. These stations are also noted with religious programs in Eng. on Mondays, Wednesdays, and Thursdays at 1705-1735. (104, 289)

Netherlands—Hilversum has changed frequency and is now using 6025 kc. rather than the 19-meter outlets. The daily pgm to N.A. begins at 2130, lasts about 40 minutes. (298)

Netherlands New Guinea—Radio Omroep Nieuw Guinea, Biak (formerly Hollandia) is

RADIO CLUBS

There are several radio clubs and organizations to which you may wish to belong. Here is a brief resume of the larger clubs.

Newark News Radio Club (NNRC)—The NNRC issues a monthly bulletin covering the broadcast, ham, FM, TV, short-wave broadcast and short-wave commercial bands. A year's membership is $4.00, and a sample bulletin and application blank may be had by writing to NNRC, 215 Market St., Newark, N. J.

Universal Radio DX Club (URDXC)—The dues of $3.00 covers membership and a total of 19 bulletins yearly which cover the short-wave broadcast and ham bands. Complete details are available from UMRXC, 21446 Birch St., Hayward, Calif.

International Shortwave Club (ISWC)—This club issues a monthly bulletin covering the short-wave broadcast and ham bands. Complete details on membership requirements and dues can be obtained from ISWC, 100, Adams Gardens Estates, London, SE 16, England.

DX Club—As mentioned in the September column, a new club, mainly for ham band DX'ers, has come into being. Dues are $2.00 ($3.50 to foreign countries except Canada and Mexico). They have recently issued their first bulletin and it contains 4½ pages of interesting items for ham DX'ers. Complete information is available from Allen Kelly, President, Route 3, Box 354-A, DeRidder, La.

heard daily at 0400-0730 on 7190 kc. In Dutch. (WC, 275)

Nicaragua—A station that is off the regular s.w. bands is Radio Atlanticco, Bluefields, on 7753 kc. This all-Spanish station is usually heavily QRM'ed by c.w. stations of the various services but the ID is easily read. It is heard from 2200 to 2300 s/off (286).

Portugal—Lisbon is widely reported and can be tuned as follows: on 9636 kc. at 2240-2300 s/off to N.A.; on 17,865 kc. in Portuguese at 1215-1300 with news at 1230; on 21,495 and 17,880 kc. in Eng. at 0815-0915 with news, talks, and classical music; on 15,100 kc. In Portuguese at 2000-2300 and on 11,640 kc. at 2115-2300. (CB, 59, 61, 104, 210)

Reunion—St. Denis, 7170 kc., 100 watts, is

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being noted from 2315 with all programs in French. The 40-meter amateur stations provide much QRN. (280)

Saudi Arabia—Jidda is being tuned on 11,850 kc. at 0600-0620. It is also scheduled, but inaudible, at 1200-1300 on 6100 kc. (11)

Sierra Leone—Freetown Calling has been heard on 3225 kc. at 0145 s/on. Eng. news is presented first; then the broadcast continues in native language. The signature tune is played on a native instrument. They verify by letter. (FW)

South Vietnam—Radio Saigon, 7290 kc., is heard well at 0830-0900 with native music and Vietnamese and French language. This

SHORT-WAVE CONTRIBUTORS

Cleveland Billiey (CB), Mahaka, E.C.D., British Guiana
Robert Brock, Jr. (RB), Nashville, Tenn.
Tom Buckley (FB), Snyder, N. Y.
Esther Cotttingham (EC), Redwood City, Calif.
Glen Cuthrell (GC), Maxton, N. C.
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Joseph Merritt (JJ), Atlanta, Ga.
Richard Miller (RM), Englewood, N. J.
Nathan Reiss (NR), New York, N. Y.
Steve Tohe (ST), Niagara-On-The-Lake, Ont.
Frank Weaver (FW), Grosse Point, Mich.
James Wade (JW), Saint John, N. B.
Michael Ward (MW), Chappaqua, N. Y.
Martin Potter (MP), London, Ont.
Chuck Maxant (CM), Baldwin, N. Y.
Peter Kiss (P), Atlanta, Ga.
Floyd Backus (FB), Richmond, Va.
Ross Brownell (RB), Vancouver, B. C.
Grady Ferguson (GF), Charlotte, N. C.
John Beaver (JB), Canon City, Colo.
Bill Hutchinson (BW), Baltimore, Md.
Bernard Brown (BB), Derby, England
J. Art Russell (JAR), San Diego, Calif.
Camilo Castillo (CA), Panama, Rep. of Panama
George Cox (GC), New Castle, Del.
Andre Myron (AM), Valleyford, Wash.
William McK. Bing (WMB), New Orleans, La.
Jack P. Hughes (JPH), Montreal, Que.
Bill Roemer (BR), Bowling Green, Ky.
James Carville (JC), Columbus, Ga.
Don Davenport (DD), Monroe, Wis.
Maurice Ashby (MA), Wichita, Kans.
George Altman (GA), Norwalk, Ohio
John Buttolph (JB), San Antonio, Tex.

is a daily xmn in the Home and Overseas Service. (61)

Spain—Radio Nacional Emisora (RNE), Madrid, has been found on 9590 kc. from 2225 with Spanish music. (59)

RNE has also been noted on the very low frequency of 2510 A kc. from 2340 with the regular N.A. Service. Has anyone else heard it here? (275)

Radio Alerta, Valencia, 6950A kc., is noted at 1500-1600. Do not confuse this with the regular RNE stations. (11)

Spanish Guinea—Bata, Rio Muni, 7698 kc., was noted from 1650 with vocals in Spanish. It appears to be under-modulating. (166)

Sweden—Stockholm has moved from 15,240 kc. to 11,705 kc. to the Middle East, and from 17,840 kc. to 11,880 kc. to the Far East. (10)

Switzerland—Frequency and schedule changes of Radio Switzerland, Berne, are as follows: to the United Kingdom and Ireland at 1345-1530 on 9656 and 7210 kc.; to South-

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east Asia and Japan at 0745-0930 on 15,305 and 21,605 kc.; to India and Pakistan at 0945-1130 on 11,865 and 21,605 kc.; to Portugal at 1545-1600 on 11,865 and 9665 kc.; to Spain at 1600-1730 on 11,865 and 9665 kc.; and to Africa at 0015-0200 on 21,520 kc. in German, French, and Italian. (61)

Uruguay—CXA71, Montevideo, is testing on 9615 kc. Tuesdays and Fridays at 1930-2130 with Eng. annms and N.A. & L.A. pop music. This is apparently the forerunner of regular broadcasts to come later. Reports go to Radio Sarandi, Montevideo. (7B, DF, 59, 149, 240)

Vatican City—The Vatican Radio can be tuned in Eng. at 1000-1015 and 1315-1345 daily on 7280, 9645, 11,685, and 15,120 kc. and at 1100-1130 Tuesdays only on 11,685 and 21,515 kc. (ST)

Among the Novice Hams
(Continued from page 83)

power is delivered to the load constantly.

Thus, a direct current of a given voltage will do more work per unit of time than an alternating current of the same peak voltage—exactly 1.41 times as much. But don’t jump to the conclusion that the power company is making a 30% profit by selling a.c. instead of d.c.

Alternating current is rated in terms of its effective value*—the amount of work it will do in comparison to a unit of direct current. Therefore, one volt (effective value) of sinusoidal alternating current actually has a peak value of 1.41 volts. The effective value and the peak value of d.c. are always equal.

Standard a.c. meters are calibrated to measure the effective values of alternating currents and voltages, rather than their peak values. Cathode-ray oscilloscopes show the peak values as well as the actual shape of the a.c. wave. Peak-reading vacuum-tube voltmeters also indicate the peak values.

Advantages of Each. The big advantage of alternating current over direct current for utility power is the ease with which it can be sent long distances from the generating plant to the consumer. It can be generated and distributed to strategically located substations at very high voltages—approaching a million volts in some installations. This means that every ampere of current represents thousands of kilowatts of power. As it is the amount of current to be carried that determines the size of wire that must be used in a transmission line, this high-voltage distribution permits carrying a maximum amount of power on a given size of conductor.

* Also called the root-mean-square (r.m.s.) value after the mathematical method of computing the effective value.
At substations, the extremely high voltages are stepped down in huge transformers to a few thousand volts and transmitted to neighborhood "pole" transformers, where they are reduced to a safer 117 or 235 volts before the power is delivered to the individual customers. Such voltage division is possible because passing a.c. through a heavy-duty type transformer very slightly affects the amount of power available. It simply changes the ratio between the current and the voltage. Thus, when the voltage is stepped down, the current available is increased, and vice versa. In contrast to a.c., once d.c. is generated at a given voltage, it is impossible to change that voltage with something as simple as a transformer. You can reduce both d.c. and a.c. by passing the current through a resistance, but this just wastes the unused power. To raise or lower d.c., you can use the current to drive another motor-generator (or dynamotor) to generate the desired new voltage. You can also convert it to a.c.—step it up or down to the desired value—and then convert it back to d.c.

Both systems are used to power mobile radio equipment from an automobile storage battery: In oscillator-type power supplies, for example, the vibrator, which is actually a vibrating switch, reverses the connections between the battery and the primary winding of the power transformer 100 to 200 times a second, thereby converting the d.c. from the battery to a.c. in the transformer, although not the sine wave a.c. shown in Fig. 1. This a.c. is then stepped up to the desired voltage in the transformer and reconverted to d.c. to power the radio.

The higher power requirements of mobile transmitters are often taken care of by dynamos driven by the battery and delivering 400 to 1000 volts, d.c.

Radio Frequencies. All radio signals are alternating currents which differ from 60-cycle power in frequency and in the fact that they are generated electronically in vacuum-tube oscillators, built up by r.f. power amplifiers, and maybe modulated.

Amateur transmitters emit signals of frequencies between 1,800,000 cps and 148,000,000 cps and higher. It is the rapidity with which they oscillate back and forth that makes them capable of being radiated into space from an antenna and of traveling great distances before being intercepted by a remote receiving antenna. (Just for the record, signals with frequencies as low as 10,000 cycles can be radiated, but it takes antennas several miles long...
to do the job.) Also, tremendous amounts of power are required to span even moderate distances at such low frequencies, while low-power high-frequency transmitters are capable of sending a signal around the world under favorable conditions.

**Frequency and Wavelength.** Electrical waves travel through space with the speed of light—186,000 miles or 300,000,000 meters per second. Consequently, the distance that a radio wave will travel in the time it takes for it to go through a complete cycle is equal to the distance traveled divided by the number of cycles, or: wavelength in meters = 300,000,000/frequency in cycles. As radio frequencies are usually given in kilocycles (thousands of cycles) or megacycles (millions of cycles), the formula is often written: wavelength = 300,000,000/freq. Conversely, freq. = 300,000,000/wavelength.

Substituting a few figures in the formulas reveals that a 3750-kc. signal has a wavelength of 80 meters, a 7000-kc. signal has a wavelength of 42.86 meters, and a 15-meter wave has a frequency of 20,000 kc.

This relationship between the frequency and the wavelength of a radio signal is of great practical importance in designing transmitting antennas, which must be of a certain length* for best results for a given frequency. Also, it is important that anyone planning to take an amateur examination be able to determine frequency when wavelength is given, and vice versa, because all classes of amateur examinations contain questions requiring knowledge of this kind.

**News and Views**

Dickie, KN4RJX, has made 11 contacts in eight states in his first six days on the air on the 40-meter Novice band. He is surprised at his good luck, because his antenna is only a 65' piece of wire 12' high with one end connected directly to his Heathkit DX-20 transmitter. Dickie plans to put up a new doublet, 22' high... Gary, WN6NLH, has kept his DX-20 transmitter and Hallicrafters S-38D receiver hot in his first month on the air. His record is 49 contacts in six states. He transmits on a folded dipole antenna and receives on a 10' vertical antenna. All work has been on the 40-meter band.

Paul, KN1CZU, operates on the 80- and 40-meter bands with a DX-20 transmitter and an old Hallicrafters Sky Champion receiver. He would like to know just how old the receiver is. In two weeks on the air,

* Usually an integral multiple of an electrical half-wavelength.
Paul has worked seven states, five confirmed. 

Bill, KN2UNQ/K2UNQ, ran out of time on his Novice license but has now received his Technician license and is about ready to try again for his General. His Novice record was 45 states worked, 34 confirmed, and five foreign countries. His transmitter is a WRL Globe Chief-90, running 75 watts, feeding off-center-fed antenna, and his receiver is an S-38D. Tom, WN3LHE, runs his “Sandwich Box” transmitter described in the March, 1956, issue of POPULAR ELECTRONICS from the accessory socket on the back of his Heathkit AR-3 receiver. Running about three watts of power into a 40-meter dipole antenna on 7152 kc., this combination has worked 13 states in one week of operation. His best report was RST599 from Florida. 

Al, KN9IDZ, likes to operate around 4:30 a.m.! It must be a good hour, because he has worked 22 states in less than a month of operating time. He transmits on a Heathkit DX-35 running 65 watts and feeding a 40-meter dipole antenna, and he receives on an S-38D.

John, KNOJLR, operates on 80 meters only with his DX-35. But he has made over 300 contacts in 27 states, Canada, and Costa Rica in four months on the air. Receiving is taken care of by a National NC-100A and a Heathkit AR-3 with a QF-1 Q-Multiplier. John offers to schedule anyone needing an Iowa contact, with a QSL card guaranteed, and will help anyone obtain his Novice license.

Don, K5BJN, has had his Conditional license for two-and-one-half months. Adding his Novice score to his new stuff worked makes him WAS (Worked All States), most of Canada, Philippines (DUT), Japan (KA2), Costa Rica (TT2), Hawaii (KH6), New Zealand (ZL) and others for 45 DX contacts. He uses a Johnson Viking II transmitter, a 136' Windom antenna, and a National NC-57 receiver. Don operates mostly on 40 and 20 meters now, but he does get on 80 and 15 at times. He will schedule anyone needing an Arkansas contact. 

John, KN4MOL, a Novice since February, is waiting for his General Class license to come through. He has made over 200 contacts in 26 states, all confirmed, as well as England, Scotland, and Puerto Rico, although he has not received QSL's (confirmations) of these foreign contacts. KN4MOL uses a DX-35 transmitter, a 

Jim, KN1DCK, Fort Devens, Mass., with his Halli- crafters 585 receiver and Heath DX-35 transmitter.

December, 1957

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Bob, KN4PEM, made only five contacts in his first two months on the air. His antenna was a 40-meter doublet fed with microphone cable in place of coaxial cable. Then, with the aid of Larry, K4LTM, he replaced the cable with RG-59/U coaxial cable. In the first week after the change, he made over 30 contacts in 15 states. His best DX is California. Bob uses an AR-3 receiver and a WRL Globe Chief transmitter. He also offers to help others become hams. . . . Richard, WN6LZZ, uses a Johnson Adventurer transmitter and a Hallicrafters S-20R receiver with a preselector (external r.f. amplifier).

New Style Call Letters
The Federal Communications Commission is running out of amateur call letters! By the end of 1957, it expects to exhaust its present supply of call letters with the single-letter W and K prefixes in the second and sixth call areas. A final decision as to what to do about this situation has not yet been made; however, according to Miss Mary Jane Morris, Secretary of the FCC, new amateur stations and stations moving into the critical areas will probably be assigned a two-letter prefix from the group WA-WZ. So don't be surprised if you soon hear WA2's and WA6's.

As of June 30, 1957, there were 160,000 amateur stations and 155,850 amateur operators authorized in the United States and its possessions. These figures do not include Novices. In the year ending June 30, the number of amateur licenses issued as a result of examinations for new or higher class licenses were: Extra—180; General—7100; Conditional—4000; Technician—6200; Novice—17,500.

added to it. In about six weeks on the air, he has worked 21 states—17 confirmed—Puerto Rico (KP4) and Hawaii (KP6).

Bob, KN4RIV, runs 70 watts to a Globe Chief transmitter feeding a 40-meter doublet about 31' high. He receives with an S-38D receiver. In his first week, Bob worked five states.

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