November, 1973 ☐ 75 cents

Electronic Servicing

A HOWARD W. SAMS PUBLICATION

Record changer workshop part 1

Quicktesting Transistors

Solving Color Problems

Starting An Auto-Sound Business

the New BUSS® *SNAP-LOCK*

Rear Panel Mounted FUSEHOLDERS

It's a "SNAP" to install....

Easy...
Quick...
Time Saving...

The new BUSS fuseholder with special "SNAP-LOCK" feature is quick and easy to install. It saves time because the fuseholder can be **pre-wired** and "snapped" quickly into place from rear of panel. A fastening nut is eliminated because the "SNAP-LOCK" feature securely holds the fuseholder in place.

The fuseholder with "SNAP-LOCK" feature is simply installed by pushing it into panel from rear side. "SNAP-LOCK" fingers engage edge of hole in panel and lock holder securely in place.

The new BUSS "SNAP-LOCK" fuseholder can be used in panels .025 to .085 inch thick. (See recommended mounting hole in dimensions below).

The BUSS "SNAP-LOCK" feature is available on the following BUSS fuseholders:

to take ¼x1¼ inch fuses:

Symbol HTA-00, Space Saver, extends just 1 in. behind panel.

Symbol HLD-00, Visual Indicating Fuseholder.

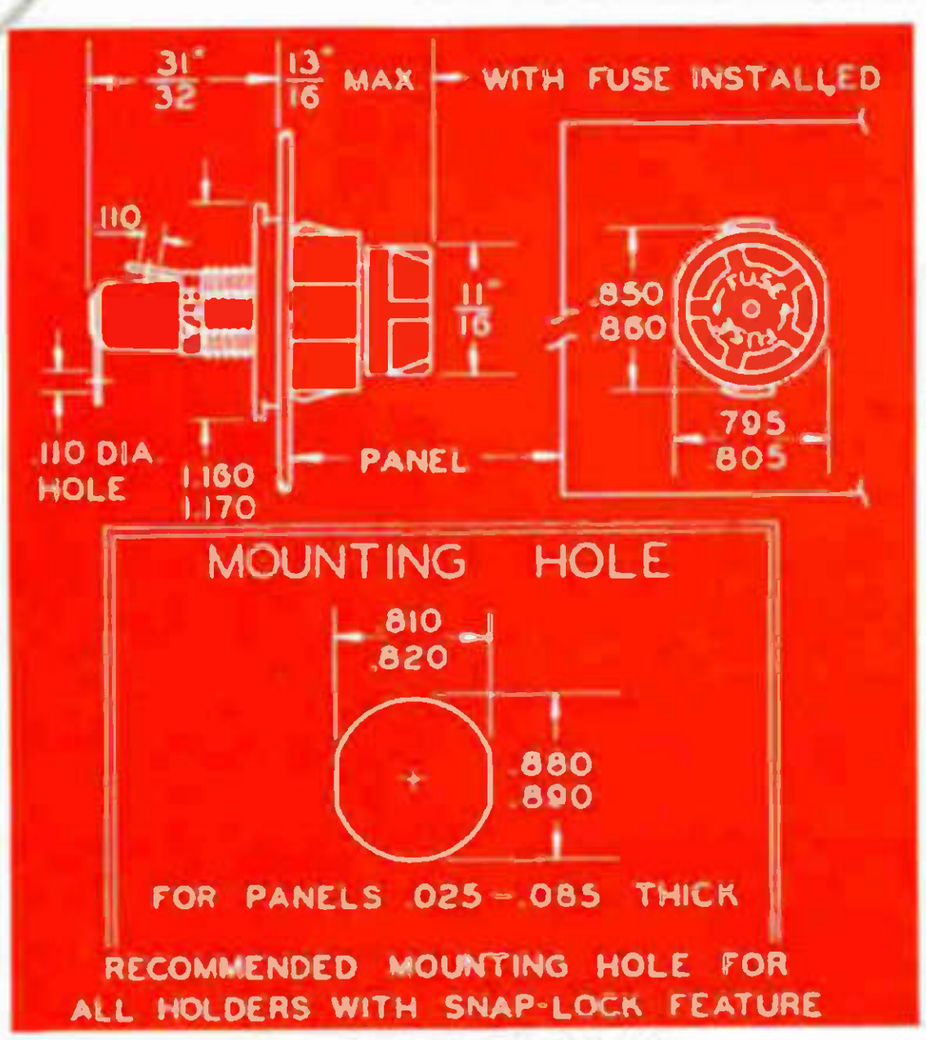
Symbol HKP-00, Standard Fuseholder.

to take ¼x1 inch fuses:

Symbol HJM-00, Standard Fuseholder.

All are available with quick connect terminals, if so desired.

HTA-00 Fuseholder-actual size



Dimensions of HTA-00 holder.
When tooling up for mounting get latest blueprint.

Also fits ½ in. knock-out in electrical boxes

BUSSMANN MFG. DIVISION
McGraw-Edison Company
St. Louis, Mo. 63107
Makers of a full line of Electric Fuses

SUPPLIED THE ECONOMICAL WAY ...THRU DISTRIBUTORS

BUSS QUALITY FUSES

Stocking these 9 ECG™ semiconductors is like having hundreds of high-voltage rectifiers on hand.

Just nine Sylvania ECG high-voltage rectifiers and triplers can replace hundreds of other types that are lurking under manufacturers' part numbers in many different TV sets.

We've also put together a brand-new cross-reference guide (ECG-212E) that makes it easy for you to find out which ECG semiconductor replaces which manufacturer's number.

And the guide isn't just limited to rectifiers and triplers. It covers over 75,000 part numbers in all, including industrial replacements.

Because so few Sylvania ECG components replace so many others, it's easy for you to have the part your customer wants.

When he wants it.

GTE SYLVANIA

GTE Sylvania Electronic Components, Waltham, Mass. 02154

Electronic Servicing®

in this issue...

DEPARTMENTS

Second class postage paid at Shawnee Mission, Kansas and additional mailing offices. Published monthly at 9221 Quivera Road, Shawnee Mission Kansas 66215 by Intertec Publishing Corp., 1014 Wyandotte St., Kansas City, Mo. 64105. Send Form 3579 to 9221 Quivera Road, Shawnee Mission, Ks. 66215.

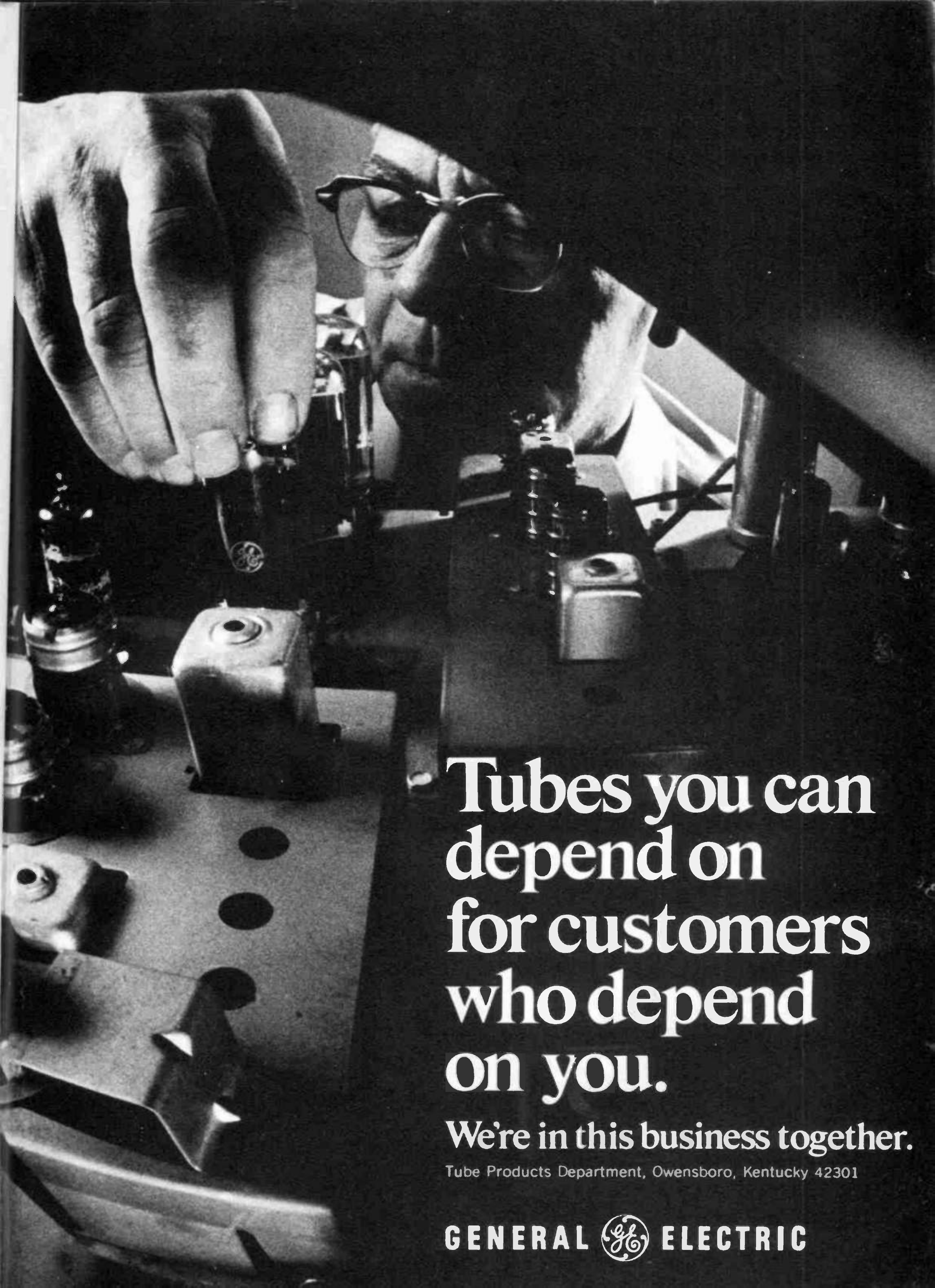
ELECTRONIC SERVICING (with which is combined PF Reporter) is published monthly by Intertec Publishing Corp., 1014 Wyandotte Street, Kansas City, Missouri 64105.

Subscription Prices: 1 year — $6.00, 2 years — $10.00, 3 years — $13.00, in the U.S.A. its possessions and Canada.

All other foreign countries: 1 year — $7.00, 2 years — $12.00, 3 years — $16.00. Single copy 75c; back copies $1. Adjustment necessitated by subscription termination at single copy rate.

Robert E. Hertel, Publisher

Intertec Publishing Corp.
Subsidiary of Howard W. Sams & Co., Inc.



Tubes you can depend on for customers who depend on you.

We're in this business together.

Tube Products Department, Owensboro, Kentucky 42301

GENERAL ELECTRIC

electronicscanner

news of the industry

A proposed "universal" warranty-claim form has been developed by a subcommittee of the Electronic Industries Association (EIA). The subcommittee chairman is John Borlaug, national service manager for GTE-Sylvania. Next, the form is to be presented for consideration before the EIA fall convention to be held in San Francisco. If adopted, the same form would be used by all electronics manufacturers for both new sales and parts warranties. Such a convenient claim form could be of immense help to independent service dealers, and roll back the present trend towards proliferation of paper work.

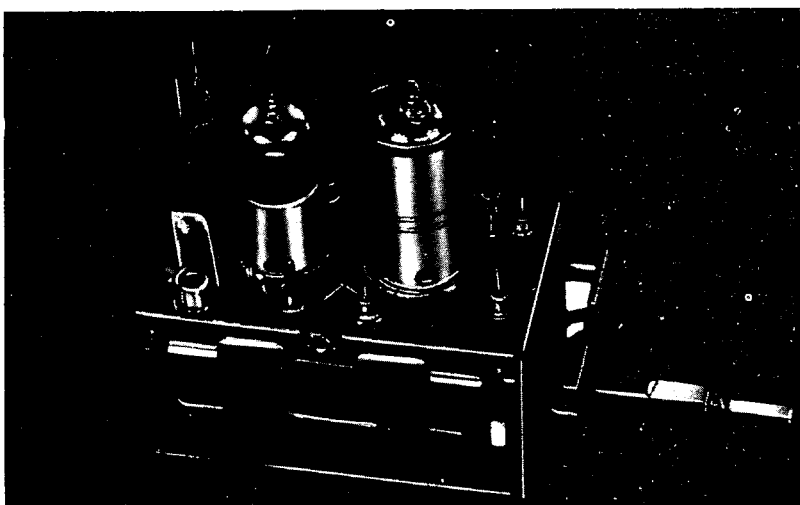
Dr. Dennis Gabor, the "father" of holography and Staff Scientist of the CBS Laboratories, has been granted a patent for a "Sonoradiography System". In this new system, ultrasonic waves and laser beams are used to probe the human body, producing a picture. The ultrasonic signal consists of short, intense pressure impulses directed through a fluid where they deform the surface of a reflecting membrane. In turn, deformations of the membrane alter the reflections of a laser beam. The interactions of sound waves and laser light produce interference patterns on the membrane, and these are photographed by a camera. Then the image is viewed by holographic techniques using a laser beam. It is hoped by CBS Laboratory scientists that the system will function as an X-ray substitute for many purposes, but without the radiation danger of X-rays.

An alert has been issued for certain Zenith 19-inch color TV receivers which might have a fire hazard. The safety defect involves an improper location of a high-voltage capacitor. Zenith distributors and dealers have been enlisted to locate the set owners from records, and perform repairs at Zenith's expense. The models suspected are: D4030W5, D4030W6, D4032W5, D4034P6 and T2838W6. Out of these, the only suspects are those with run numbers 226C and 227C which also have serial numbers in one of these series: 6505665-6508999, 6513900-6514999, 6525385-6526999, 6527000-6529999, 6536000-6539427, 6550000-6550669, and 6553000-6553720. Any of these sets should be unplugged and not used until inspected and repaired, if necessary.

JVC expects a patent will be granted soon for the 4-channel-disc Shibata stylus developed by the Victor Company of Japan. After the patent is issued, JVC immediately will begin licensing diamond-stylus manufacturers to produce this stylus in the United States.

An attempt by Mercury Electronics Corporation to acquire rights to the Emerson name has failed. According to **Merchandising Week,** National Union Electric Corporation, which owned Emerson before it ceased operations, since then has opened discussions with several other companies who are interested in buying the name.

(Continued on page 6)



$9.95

ALL PARTS INCLUDED

EXCEPT TUBES & TRANSISTORS

ONE YEAR GUARANTEE

TUNER SERVICE CORPORATION

PROVIDES YOU WITH A COMPLETE SERVICE FOR ALL YOUR TELEVISION TUNER REQUIREMENTS.

REPAIR

VHF Or UHF Any Type $9.95.
UHF/VHF Combo $15.00.

In this price all parts are included, tubes, transistors, diodes, and nuvistors are charged extra. This price does not cover mutilated tuners.

Fast efficient service at our conveniently located service centers.

All tuners ultrasonically cleaned, repaired, realigned and air tested.

REPLACE

Universal Replacement Tuner **$9.95**

This price buys you a complete new tuner built specifically by **SARKES TARZIAN INC.** for this purpose.

All shafts have a maximum length of 10½" which can be cut to 1½".

Specify heater type parallel and series 450mA or 600mA.

CUSTOMIZE

Customized tuners are available at a cost of only $15.95; (with trade-in **$13.95**)

Send in your original tuner for comparison purposes.

TSC

WATCH US GROW

HEADQUARTERS	BLOOMINGTON, INDIANA 47401	537 S. Walnut Street	Tel. 812-334-0411
ARIZONA	TUCSON, ARIZONA 85713	1528 So. 6th Street, P.O. Box 4534	Tel 602-791-9243
CALIFORNIA	NORTH HOLLYWOOD, CALIF. 91601	10654 Magnolia Boulevard	Tel. 213-769-2720
	BURLINGAME, CALIF. 94010	1324 Marsten Road	Tel. 415-347-5728
	MODESTO, CALIF. 95351	123 Phoenix Avenue	Tel. 209-521-8051
FLORIDA	TAMPA, FLORIDA 33606	1505 Cypress Street	Tel. 813-253-0324
GEORGIA	ATLANTA, GEORGIA 30310	938 Gordon Street S.W.	Tel. 404-758-2232
ILLINOIS	CHICAGO, ILLINOIS 60621	741 West 55th Street	Tel. 312-873-5555-6-7
	SKOKIE, ILLINOIS 60076	5110 West Brown Street	Tel. 312-675-0230
INDIANA	HAMMOND, INDIANA 46323	6833 Grand Avenue	Tel. 219-845-2676
	INDIANAPOLIS, INDIANA 46204	817 North Pennsylvania St.	Tel. 317-632-3493
KENTUCKY	LOUISVILLE, KENTUCKY 40208	2920 Taylor Boulevard	Tel. 502-634-3334
MARYLAND	BALTIMORE, MD. 21215	5505 Relstertown Rd., P.O. Box 2624	Tel. 301-358-1186
MISSOURI	ST. LOUIS, MISSOURI 63132	10530 Page Avenue	Tel. 314-429-0633
NEVADA	LAS VEGAS, NEVADA 89108	3816 Vegas Drive	Tel. 702-648-1450
NEW JERSEY	JERSEY CITY, NEW JERSEY 07307	547-49 Tonnele Avenue HWY 1&9	Tel. 201-792-3730
	TRENTON, NEW JERSEY 08638	901 N. Olden Ave.	Tel. 609-393-0999
OHIO	CINCINNATI, OHIO 45216	7450 Vine Street	Tel. 513-821-5080
	CLEVELAND, OHIO 44109	4597 Pearl Road	Tel. 216-741-2314
	TOLEDO, OHIO 43624	119 North Erie Street	Tel. 419-243-6733
OREGON	PORTLAND, OREGON 97210	1732 N.W. 25th Avenue	Tel. 503-222-9059
TENNESSEE	GREENEVILLE, TENNESSEE 37743	1215 Snapps Ferry Road	Tel. 615-639-8451
	MEMPHIS, TENNESSEE 38114	1703 Lamar Avenue	Tel. 901-278-4484
TEXAS	DALLAS, TEXAS 75218	11540 Garland Road	Tel. 214-327-8413
VIRGINIA	NORFOLK, VIRGINIA 23502	4538 East Princess Anne Rd.	Tel. 703-855-9955

FOR INFORMATION ON FRANCHISE, CONTACT HEADQUARTERS

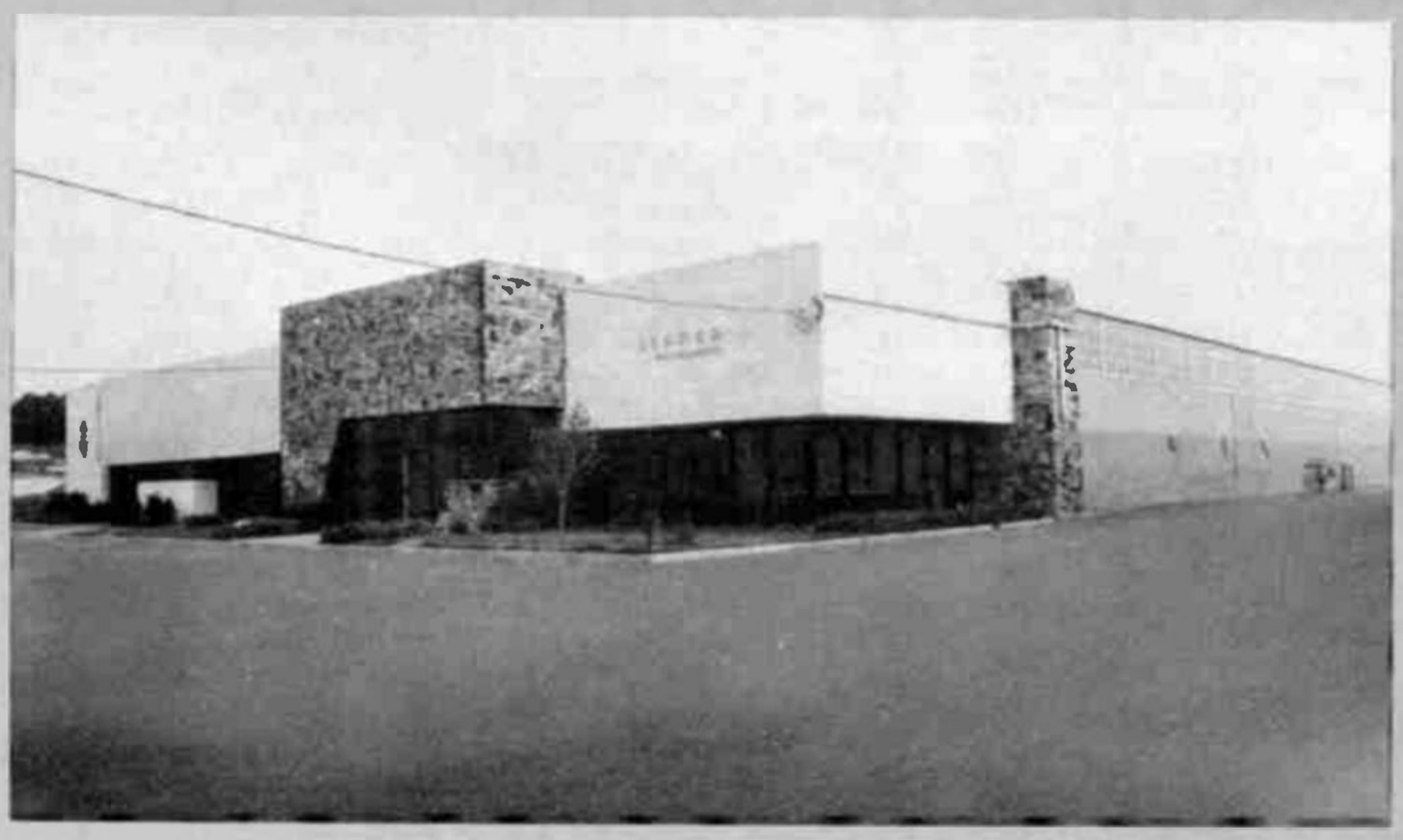
For More Details Circle (3) on Reply Card

The Electronic Tube Division of GTE-Sylvania recently produced its 10-millionth color picture tube. Including both b-w and color, total CRT production to date has been 53 million. The first Sylvania color picture tube was built in 1955, and now there are 62 types of color tubes in the Sylvania line.

RCA is greatly expanding its world-wide sales and manufacturing activities. RCA has announced start of construction of an $8-million plant in the capital city of Malaysia. In the new plant, linear and digital IC's, transistors, thyristors, and other products will be manufactured. Other plants in foreign countries are located in Liege, Belgium, Taiwan, and Sunbury-on-Thames, England. Also, the **Wall Street Journal** reports that RCA is to build a $15-million plant in Brazil for the manufacturing of b-w and color TV receivers. Color broadcasting was initiated last year in Brazil. According to **Radio & Television Weekly**, RCA has received its largest export order, and will ship color sets from the Bloomington, Indiana plant to Lai Fu Trading Company, Ltd., the new RCA distributor in Taiwan.

A warning has been issued by the federal Consumer Product Safety Commission to owners of the "Little Wonder TV Antennas" advising them to disconnect the antennas immediately because the product contains no protection against electrical shock. The antenna, distributed nationally by two little-known mail-order firms, plugs into AC power outlets in homes.

Leader Instruments now is occupying a new facility, located at 151 Dupont Street, Plainview, Long Island, New York, which more than doubles the former working area. Samuel R. Eisenberg, president of Leader, announced that the new 30,000 square-foot building was needed to handle the companies increased volume of business. □



B&K introduces two ways to make troubleshooting easier.

Few things are handier on a troubleshooting job than a good substitution box. That's why B&K takes pride in introducing our newest and handiest substitution boxes—at prices you wouldn't expect.

Our new Model 2901 is an ultra-compact, 36-component box with full protection for the circuits, the components, and you. It features a high-capacity (1000 mfd), low-voltage capacitor for transistorized circuits, and a special surge protection circuit that prevents arcing and healing of electrolytics. And it's all in a rugged box weighing only 1¼ pounds.

Our new Model 2902 Substitution Master gives you an array of 76 most-needed resistors and capacitors, including 20 electrolytics with special capability for transistorized circuits—plus a diode rectifier. Its special surge protection circuit reduces problems by preventing arcing and healing of electrolytics; low-voltage electrolytics are protected by a front-panel overload indicator. The 2902 lets you select up to 5 components for simultaneous substitution, including signal and power resistors, paper/disc and electrolytic capacitors.

Thus you can make up a simple but complete power supply circuit, including bleeder and power resistors, filter capacitors, and the rectifier. Or you can make up a voltage divider by selecting the 2 resistors of the desired values. For their capabilities, our Models 2901 and 2902 Substitution boxes are the best values on the market today.

Whichever you choose, we think it will prove to be one of your most valuable troubleshooting tools. And that's just what you'd expect from B & K.

Contact your distributor, or write Dynascan Corporation.

$74.95 (Model 2902)

$39.95 (Model 2901)

B&K Very good equipment at a very good price.

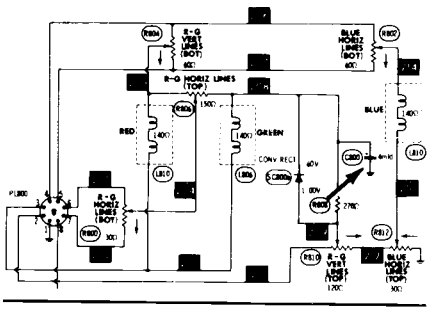
Product of Dynascan Corporation/1801 W. Belle Plaine Ave., Chicago, Ill. 60613

For More Details Circle (4) on Reply Card

troubleshooting tips

Send in your helpful tips—we pay!

Sudden change of vertical convergence
Sylvania D15 chassis
(Photofact 1184-3)



When the vertical convergence changes suddenly, and you can't converge the red-and-green vertical lines at top or bottom, check C800, which is located on the convergence board. It is likely to be shorted.

F. B. Knoesel
San Angelo, Texas

Excessive tube and flyback failures
General Electric CB-21 color TV chassis
(Photofact 843-1)

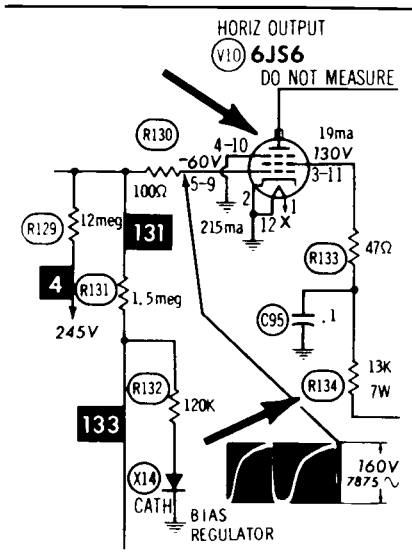
A common failure is for the flyback transformer to overheat and eventually fail. When GE's recommended EU77X15 high voltage and pulse coils are used as replacements, the transformer runs cool, but the cathode current of the 6JS6 often can't be dipped below 220 milliamperes, and the width is barely enough or too narrow.

To increase the width of the CB-25, GE recommends adding a 82 to 100 pf capacitor from pin 4 of the flyback to ground. Of course, this widens the picture of a CB-21 as well, but it raises the current even higher. Reducing the value of the screen resistor back to 13K (where it was before installation of the new flyback) helps the width, but increases the current even more. This excessive current is undesirable, and could lead to a callback if not corrected.

The best fix I've found is to replace the 6JS6 with a 6KD6, which will take up to 260 milliamperes. Two precautions should be observed. You must bend the plate cap (or replace it with a smaller one) to fit the smaller plate. And make sure nothing is tied to pin 9, because 9 and 5 are tied together internally in the 6KD6.

In one chassis, recently modified, a 6KD6 with a 100 pf capacitor and a 15K screen resistor produced about 2 inches of overscan and dipped at less than 200 milliamperes.

J. E. Strenk, CET
Rhinebeck, New York



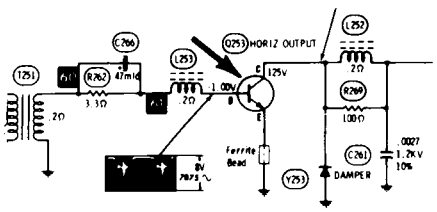
Horizontal output transistor fails repeatedly
General Electric U-1 chassis
(Photofact 1257-2)

Ohmmeter tests showed R264 to be open and Q253 (horiz-output transistor) to have a collector-to-emitter short. I replaced the resistor, removed the transistor, and substituted a diode for the base/emitter junction of Q253. Waveshape and amplitude of the signal at the base appeared to be normal. I installed a new transistor.

When the set was turned on, there was no picture. Also, a neon bulb held near the flyback transformer would glow only when the high-voltage rectifier (Y254) was disconnected.

I replaced the high-voltage rectifier unit and the receiver worked fine for about a minute, then the screen went black and R264 started to overheat. Yes, the output transistor was shorted. I replaced it the second time.

Because the transistor seemed to operate for nearly a minute without damage, I operated the set for about ten seconds at a time. Soon I found a faint arcing sound and a sulphurous smell from the new high-voltage rectifier. You guessed it, the replacement had gone bad, also. Replacing it a second time cured the problem.



Roger D. Redden
Beaver, West Virginia

Intermittent blooming
RCA CTC22AD color TV chassis
(Photofact 1107-1)

The picture on this receiver would often pull-in about 2 inches on each side, then return to full width. We thought this caused by a defect in the brightness limiter or high-voltage regulator circuits, but extensive testing proved nothing.

While moving a test lead near the 11HM7 video-output tube, I accidentally hit the tube, and the screen narrowed, then bloomed so the raster was lost. Replacement of the tube cured the blooming.

When tested in a tube checker, the defective 11MH7 showed a sudden drastic change of Gm each time it was tapped. Apparently, the tube had loose elements or a badly contaminated grid, and the extra brightness caused by this defect would overload the high voltage and start the blooming.

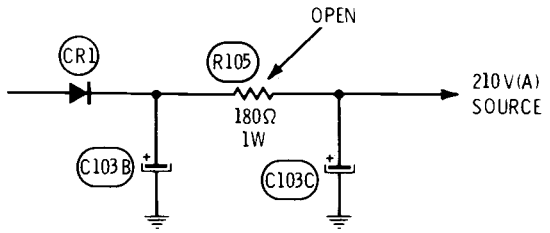
Since that time, three more of these sets have come to the shop with the same symptoms and the same defective video output tubes.

Joseph Rotello, Jr.
Tucson, Arizona □

syncure

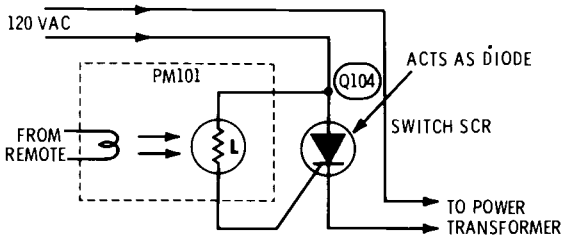
Symptoms and cures compiled from field reports of recurring troubles

Chassis—RCA CTC46 and CTC48
PHOTOFACT—1243-2 and 1300-2



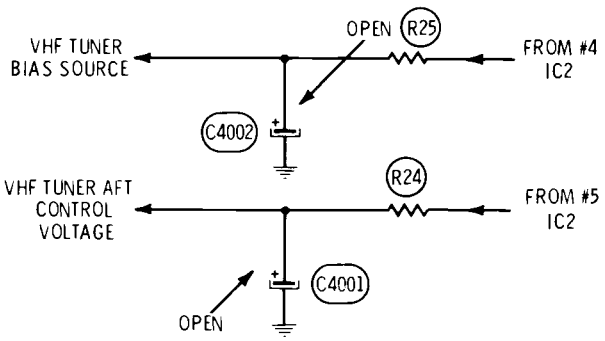
Symptom—Excessive brightness with retrace lines
Cure—Check R105, and replace if it is open

Chassis—RCA CTC54 (and others with remote control)
PHOTOFACT—1254-2



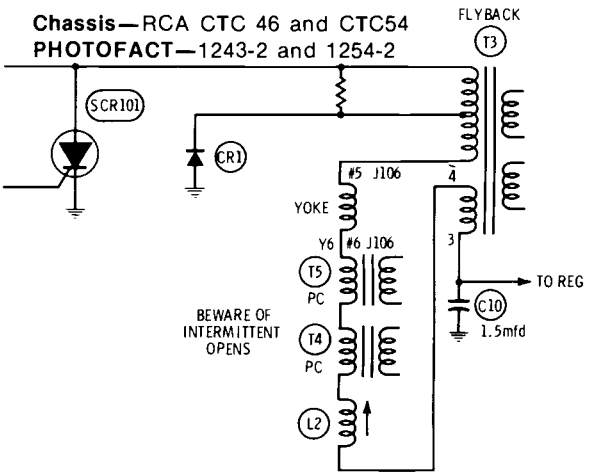
Symptom—Circuit breaker opens at turn on
Cure—Check SCR Q104, and replace if acting as a diode

Chassis—RCA CTC46 and CTC48
PHOTOFACT—1243-2 and 1300-2



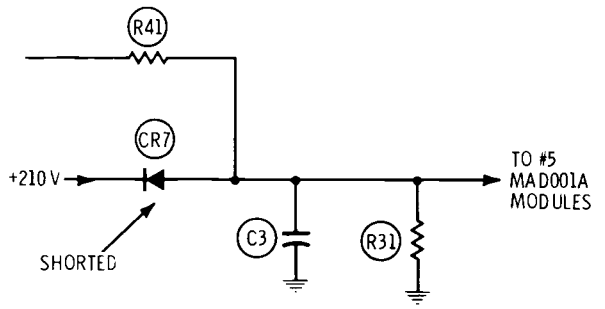
Symptom—Herringbone interference pattern
Cure—Check C4001 and C4002, and replace if open

Chassis—RCA CTC 46 and CTC54
PHOTOFACT—1243-2 and 1254-2



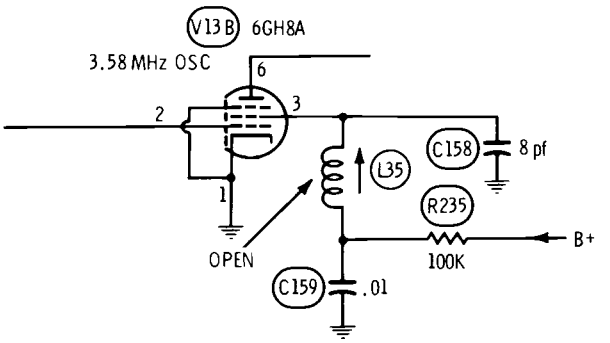
Symptom—Excessive failure of SCR101
Cure—Check for erratic connections in the yoke circuit

Chassis—RCA CTC46 and CTC48
PHOTOFACT—1243-2 and 1300-2



Symptom—Excessive brightness
Cure—Check CR7, and replace if shorted

Chassis—RCA CTC39
PHOTOFACT—1126-3



Symptom—No color
Cure—Check oscillator coil L35, and replace if open

TV TUNER SERVICE

PTS ELECTRONICS, INC.

ALSO AVAILABLE IN . . .

MINNEAPOLIS-ST. PAUL
WASHINGTON, D.C.
KANSAS CITY
NEW ORLEANS
PORTLAND, OR.
OKLAHOMA CITY
HOUSTON
BUFFALO, N.Y.

now you too...

...get Fast hr. Service!

$9.95

All PTS BRANCHES are wholly owned subsidiaries of PTS ELECTRONICS, INC. (NO FRANCHISES!) and report directly to the Home Office in Bloomington, Indiana. Only this way can we guarantee the same quality—PRECISION TUNER SERVICE—that made PTS the leader in this field.

PTS is proud to be the only tuner service to publish a (80 pages of tuner blow-ups, tuner-antenna coil-and shaft replacement guides available for $1.00).

WE OFFER MORE. SERVICE IS EVERYTHING WITH US.
WE ARE DYNAMIC AND FAST. TRUSTWORTHY.

You and Us - A True Partnership.

PTS ELECTRONICS, INC. is recommended by more TV manufacturers and overhauls more tuners than all other tuner services combined!

for finer, faster,

PTS

Color • Black & White • Transistor Tubes • Varactor • Detent UHF
All Makes

VHF, UHF or FM $9.95
UV-COMBO 16.95
IF-SUBCHASSIS 12.50

Major parts and shipping charged at cost.
(Dealer net!)

over 4000 exact tuner replacements available for $14.95 up (new or rebuilt)

Send faulty unit with tubes, shields and all broken parts to

PTS ELECTRONICS, INC.

INDIANA—HOME OFFICE:
PTS ELECTRONICS, INC.
P.O. BOX 272
BLOOMINGTON, IND. 47401
TEL. 812, 824-9331

NORTHERN CALIFORNIA:
PTS ELECTRONICS, INC.
P.O. BOX 41354
SACRAMENTO, CALIF. 95841
TEL. 916, 482-6220

SOUTHERN CALIFORNIA:
PTS ELECTRONICS, INC.
P.O. BOX 5784
SAN DIEGO, CALIF. 92105
TEL. 714, 280-7070

COLORADO:
PTS ELECTRONICS, INC.
P.O. BOX 672
ARVADA, COLO. 80001
TEL. 303, 423-7088

FLORIDA:
PTS ELECTRONICS, INC.
P.O. BOX 7923
JACKSONVILLE, FLA. 32210
TEL. 904, 388-9952

INDIANA:
PTS ELECTRONICS, INC.
P.O. BOX 272
BLOOMINGTON, IND. 47401
TEL. 812, 824-9331

KANSAS:
PTS ELECTRONICS, INC.
3116 MERRIAM LNE.
KANSAS CITY, KANSAS 66106
TEL. 913, 831-1222

LOUISIANA:
PTS ELECTRONICS, INC.
2914 WYTCHWOOD DR.
METAIRIE, LA. 70033
TEL. 504, 885-2349

MARYLAND:
PTS ELECTRONICS, INC.
1105 SPRING ST.
SILVER SPRINGS, MD. 20910
TEL. 301, 565-0025

MASSACHUSETTS:
PTS ELECTRONICS, INC.
P.O. BOX 3188
SPRINGFIELD, MASS. 01103
TEL. 413, 734-2737

MINNESOTA:
PTS ELECTRONICS, INC.
815 W. LAKE ST.
MINNEAPOLIS, MINN. 55408
TEL. 612, 824-2333

MISSOURI:
PTS ELECTRONICS, INC.
3116 MERRIAM LNE.
KANSAS CITY, KANSAS 66106
TEL. 913, 831-1222

NEW YORK
PTS ELECTRONICS, INC.
993 SYCAMORE ST.
BUFFALO, N.Y. 14212
TEL. 716, 881-4935

NEW JERSEY - N. Y. CITY
PTS ELECTRONICS, INC.
158 MARKET ST.
E. PATERSON, N.J. 07407
TEL. 201. 791-6380

OHIO:
PTS ELECTRONICS, INC.
5682 STATE RD.
CLEVELAND, OHIO 44134
TEL. 216, 845-4480

OKLAHOMA:
PTS ELECTRONICS, INC.
P.O. BOX 60566
OKLAHOMA CITY, OKLA. 73106
TEL. 405, 947-2013

OREGON:
PTS ELECTRONICS, INC.
P.O. BOX 13096
PORTLAND, OREGON 97213
TEL. 503, 282-9636

PENNSYLVANIA:
PTS ELECTRONICS, INC.
P.O. BOX 16856
PHILADELPHIA, PA. 19142
TEL. 215, 724-0999

PTS ELECTRONICS, INC.
P.O. BOX 4130
PITTSBURGH, PA. 15202
TEL. 412, 761-7648

TEXAS:
PTS ELECTRONICS, INC.
P.O. BOX 7332
LONGVIEW, TEX. 75601
TEL. 214, 753-4334

PTS ELECTRONICS, INC.
P.O. BOX 26616
HOUSTON, TEX. 77032
TEL. 713, 644-6793

WASHINGTON, D.C.:
PTS ELECTRONICS, INC.
1105 SPRING ST.
SILVER SPRINGS, MD. 20910
TEL. 301, 565-0025

reader's exchange

Needed: *Schematic and instruction manual for New London Instrument Company FM modulation-monitor model 257.*

ALSYNCO
171 South Main Street
Natick, Massachusetts 01760

Needed: *Source for vintage radio tubes. Needed now—UX120 and UX199.*

Larson's Television
Village of Orilla
Cummings, Iowa 50061

For Sale: *Antique tubes, all types. Guaranteed satisfactory. Also Riders Radio and TV Manuals.*

Goodwin Radio Shop
Rankin, Illinois 60960

Needed: *Schematic for a RCA-WO-56A oscilloscope and a 650 Triplett VTVM. Will pay, or copy and return.*

Leland E. Du Buque
1440 Knights Row
Yuba City, California 95991

Needed: *Schematic and parts list for an Ecco-Fonic tape-type echo and reverb unit. Top plate says model 109C. Side plate says model E. Will pay reasonable fee.*

Byron Bateman
1575 Margie Drive
Sandy, Utah 84070

Needed: *Schematic or service information for Sony HP-140 stereo receiver.*

Peter Cicero
112-19 Jamaica Avenue
Richmond Hill, New York 11418

Needed: *Service literature for a Candle model MT-510A micro TV.*

J. M. Sullivan
1313 George Washington Way
Richland, Washington 99352

Needed: *45-RPM spindle, part number AD5481 for the Olympic stereo radio-phono model 728.*

V. R. Silva
2451 Church Lane
San Pablo, California 94806 □

One – or more – of these Sams books may make life easier for you.

Sams is the nation's leading publisher of authoritative technical books and service manuals for electronics servicemen and technicians. Ten of their newest time-saving and problem-solving texts and references are shown here. Send for the ones that can help you—and for the free 1973 Sams Catalog, too.

COLOR-TV FIELD-SERVICE GUIDE—Vol. 4
by The Howard W. Sams Engineering Staff
The latest in Sams authoritative series of guides for use while servicing color television in the customer's home. It covers over 1800 models made between 1970 and 1972, with detailed chassis layouts, adjustment procedures, schematics, etc. A real time-saver.
No. 20953 $4.95

COLOR-TV SERVICING MADE EASY—Vol. 3
by Wayne Lemons and Carl Babcoke
Covers the many advances and introductions made by the industry since publication of the first two volumes. Update your knowledge and skills with its full coverage of such innovations as high-voltage regulators, "fail-safe" circuits, atc circuits, etc., as well as its coverage of new chassis series and circuitry from the leading manufacturers.
No. 20875 $6.95

TRANSISTOR SPECIFICATIONS MANUAL—6th Edition
by The Howard W. Sams Engineering Staff
Lists the electrical and physical parameters, along with the manufacturers of over 12,000 transistor types. Gives complete data for every specification you'll require, and includes dimensional drawings for non-standard cases. An invaluable, time-saving aid.
No. 20974 $4.50

TRANSISTOR SUBSTITUTION HANDBOOK—13th Edition
by The Howard W. Sams Engineering Staff
This updated guide lists well over 100,000 substitutions that can be safely made in replacing transistors. All substitutes were selected by computer following over a billion comparisons of data. Accurate, complete, even to the inclusion of manufacturers' recommendations for general replacement transistors.
No. 20954 $2.95

AUTOMOBILE ELECTRONICS SERVICING GUIDE
by Joseph J. Carr
Covers the servicing of am and fm car radios, cassettes, eight-track cartridges, pushbutton, manual and signal-seeking tuners in complete detail. Presents the knowledge needed to do an increasingly more complicated job with confidence.
No. 20927 $4.95

TRANSISTOR RADIO SERVICING MADE EASY—3rd Edition
by Wayne Lemons
Step-by-step explanations of how to find and repair the faults causing a weak, dead, noisy or squealing radio. A completely practical book that enables you to repair transistor radios including fm with maximum profit.
No. 20976 $4.50

1-2-3-4 SERVICING TRANSISTOR CB & TWO-WAY RADIO
by Forest H. Belt
Following the highly popular 1-2-3-4 method of finding and fixing trouble in electronic equipment, this new book provides the knowledge that enables you to service both CB and commercial two-way radios, logically and quickly.
No. 20965 $5.25

FOUR-CHANNEL SOUND
by Leonard Feldman
If you are faced with working on a four-channel set, converting one, or you just want to learn more about this newest development in sound recording and listening—this book contains the information you need.
No. 20966 $4.50

QUESTIONS AND ANSWERS ABOUT PAY TV
by Ira Kamen
Pay tv is with us for "keeps" and is well financed by business and the motion picture industry. Electronics technicians will want to know as much as they can about this growing entertainment service. This book fully answers their questions.
No. 20971 $4.95

BUILDING & INSTALLING ELECTRONIC INTRUSION ALARMS
by John E. Cunningham
This is a fast-growing new field for the electronics serviceman, and this new book covers it fully. Many practical, tested circuits you can build. Included are chapters on electromechanical alarms, sensors and switches; audio and vibration alarms, photoelectric, proximity and ultrasonic alarms; closed-circuit television, auto protection, etc.
No. 20929 $4.50

ES-113

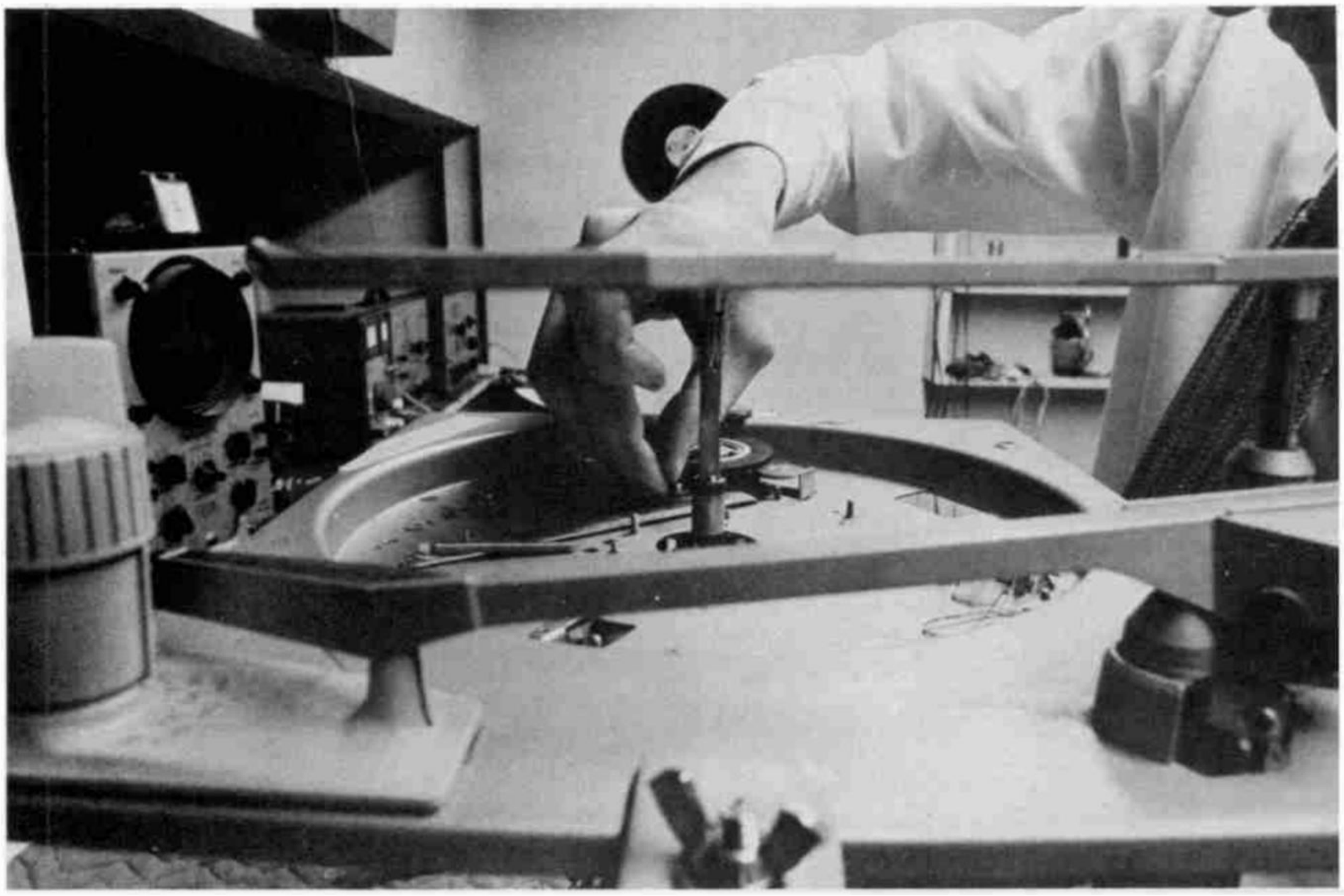
HOWARD W. SAMS & CO., INC.
4300 West 62nd Street, Indianapolis, Indiana 46268

Order from your Electronics Parts Distributor, or mail to Howard W. Sams & Co., Inc.
Send books checked at right. $_____ enclosed.
Please include sales tax where applicable.
☐ Send FREE 1973 Sams Book Catalog.

☐ 20953 ☐ 20976
☐ 20875 ☐ 20965
☐ 20974 ☐ 20966
☐ 20954 ☐ 20971
☐ 20927 ☐ 20929

Name _____
(Please print)
Address _____
City _____ State _____ Zip _____

For More Details Circle (9) on Reply Card



part 1

Record changer workshop

By Forest H. Belt, CET

No one knows for sure why most technicians hate to tackle a record changer or automatic turntable. Perhaps it's because they lack training in how to repair them; most schools neglect this particular subject.

Some technicians say they just don't have the "knack" for troubleshooting mechanical equipment. Not true! You don't need any special talent or energy to repair hi-fi turntables successfully. You do need two things: some knowledge of what all those gears, wheels, bars, and slides are doing, and a fundamental servicing approach that adapts to any mechanism. With this basic understanding, no record-changing device can stump you for long. Let's discuss an "approach" first.

Efficient technicians divide their initial troubleshooting into five facets: cleanup, inspection, testing, adjustments, and diagnosis. This Workshop session covers the first three. You'll see exactly what constitutes a thorough cleaning. Lubrication can be part of cleanup, but something you do sparingly. The cleaning process often cures certain faults without you even bothering to test for them.

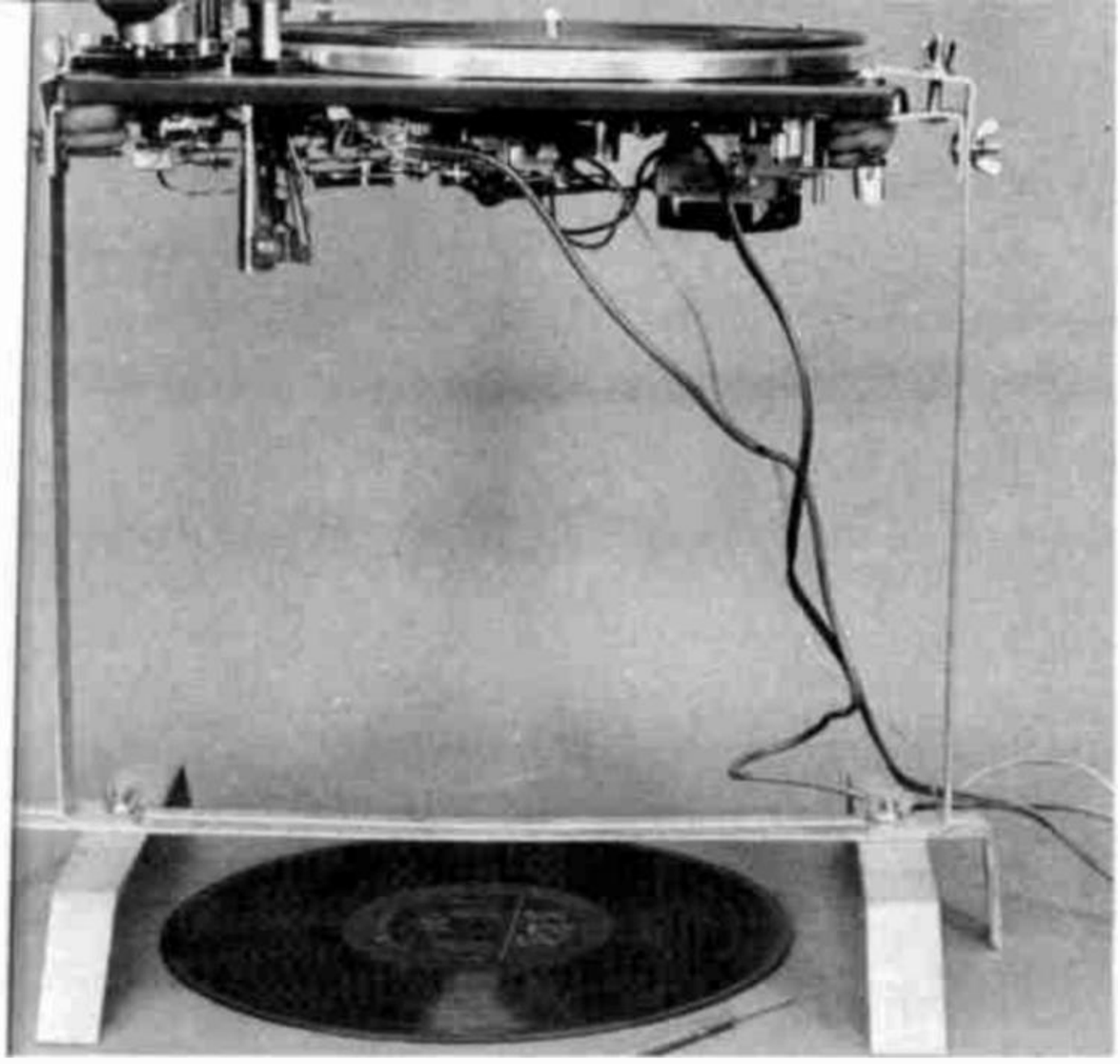
Inspection leads you to other faults. So do specific tests, also described in this session. Part 2 shows you how adjustments ascertain proper changer/turntable operation. And then, two more Workshops take you inside a typical changer and turntable mechanisms. That's what you need for intelligent overall diagnosis.

Now, follow the various steps and see, in sharp closeup photos, how you can profitably approach automatic-changer servicing.

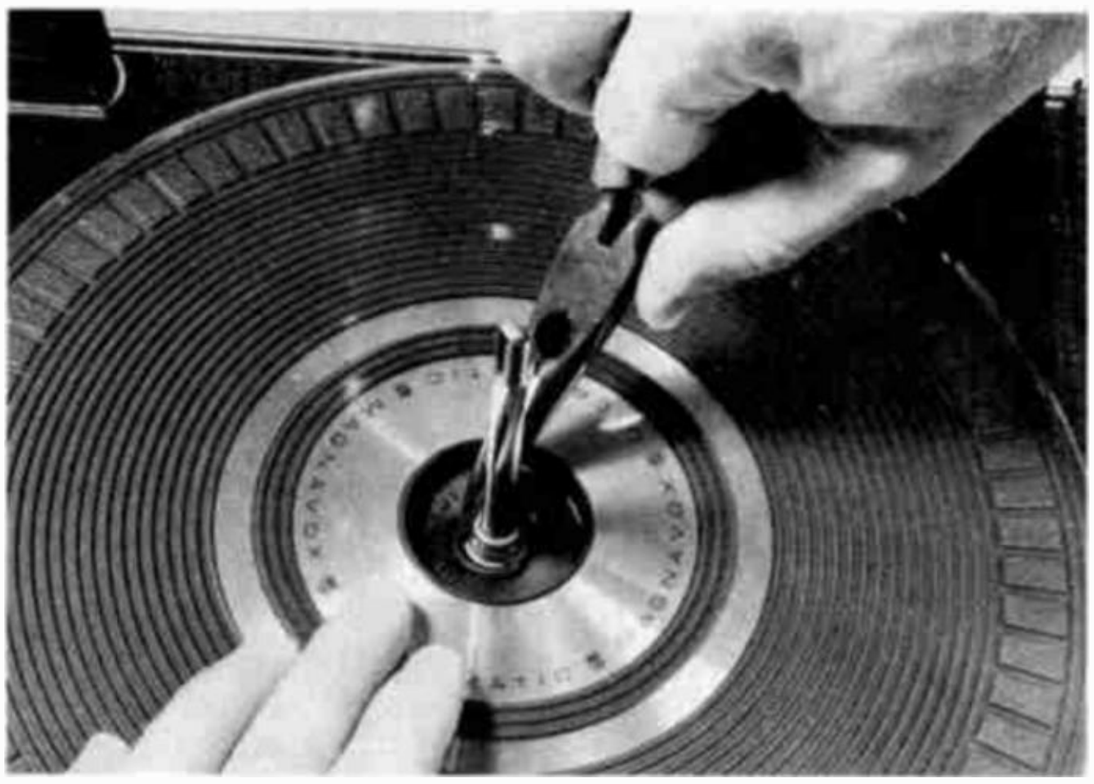
The well-known author/photographer of this new series, Forest H. Belt, is a former editor of Electronic Servicing, and has written several Howard W. Sam's books. For some of these books, he and his associates have spent many hours lab-testing new repair methods and taking detailed photographs of the latest equipment.

From this advance service information. Mr. Belt will present a series of "direct-view" workshops [next best to hands-on study].

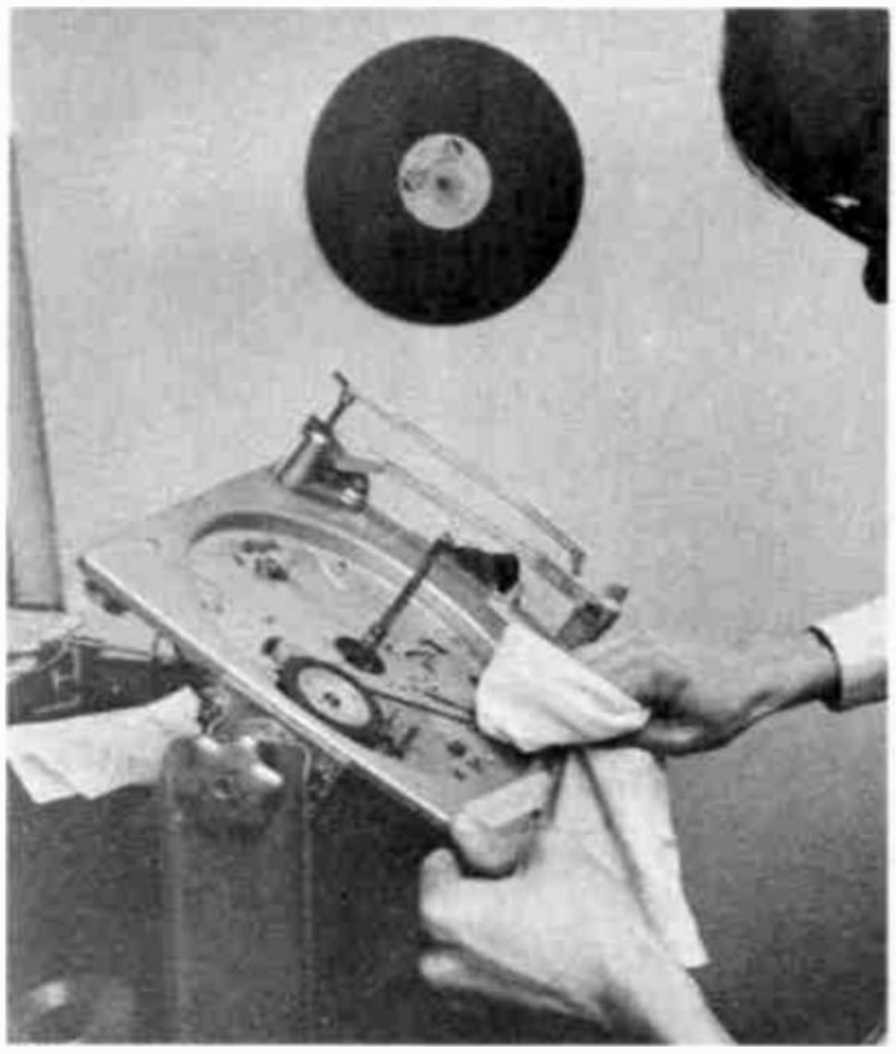
If you like coverage of this type, let us know, and the series can be extended to other types of equipment.



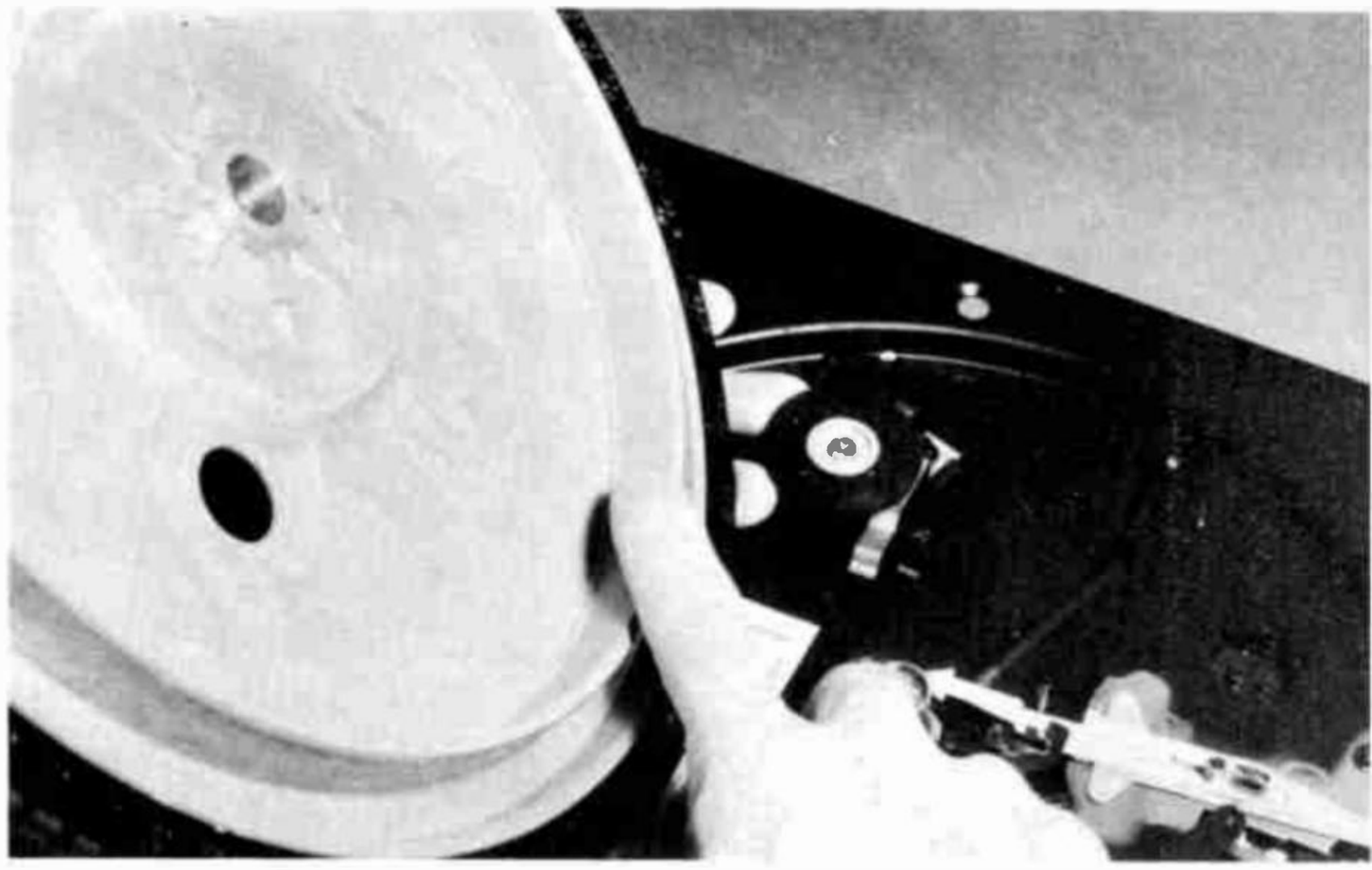
A servicing rack brings several advantages. You can watch changer operations easily. Parts and assemblies are accessible for repair and replacement. Your parts distributor carries these repair stands in stock or can order one for you. Caution: Use soft padding between the clamps and the turntable baseplate, to prevent scratches (you can glue automobile gasket material to the clamp faces).



Step 1. Cleaning comes first. Most record changers and hi-fi turntables are grimy inside. Remove the turntable platter. A clip may hold it in place, or a rubber or plastic O-ring. Top-line automatic and manual turntables might not have a clip, with the platter held in place only by its own weight and bulk. Remove the spindle before you lift any platter, if you can. When replacing the platter over a fixed spindle, lift the guide tab to let the platter hole past the spindle offset.



Step 2. Wipe out the dust and accumulated dirt above and below the baseplate. It often is caked; evaporating oil mixes with dust to form a scum. Use alcohol to help cut the layer. Don't use carbon tetrachloride. Clean each machine thoroughly before you even begin to service it. Don't do any lubricating at this point.



Step 3. The platter rim must be cleaned with alcohol repeatedly until a drying cloth comes away without any trace of dirt. Even "invisible" residue here, such as left by your fingers, can introduce slippage that causes wow or lets the changer stall in-cycle. ALWAYS clean this surface before you begin other servicing. Then clean it again the last thing before you finish the job.

(Continued on page 20)

Kit...or

Heath test equipment is your best buy

Now you can buy Heath test equipment in easy-to-assemble kit form... or factory-assembled and calibrated. Either way you get service equipment with all the things Heath has become famous for: high quality... low direct-to-you prices... trustworthy specifications... long-term reliability... simple, rugged design... necessary features and functions built-in, not optional... manuals with complete schematics, circuit descriptions, parts lists and operating instructions... handsome brown & beige styling for our kits, striking black and white for the assembled versions... and local sales and service at Heathkit Electronic Centers in major metropolitan areas.

And you get something else that's really more important than excellent engineering or realistic prices: the total support and attention of everyone at Heath... honest, friendly, capable people sincerely interested in solving your problems and answering your questions. At Heath, "the customer is always right" is not a slogan... it's a way of life.

Kit and assembled instruments available across the country at Heathkit Electronic Centers:

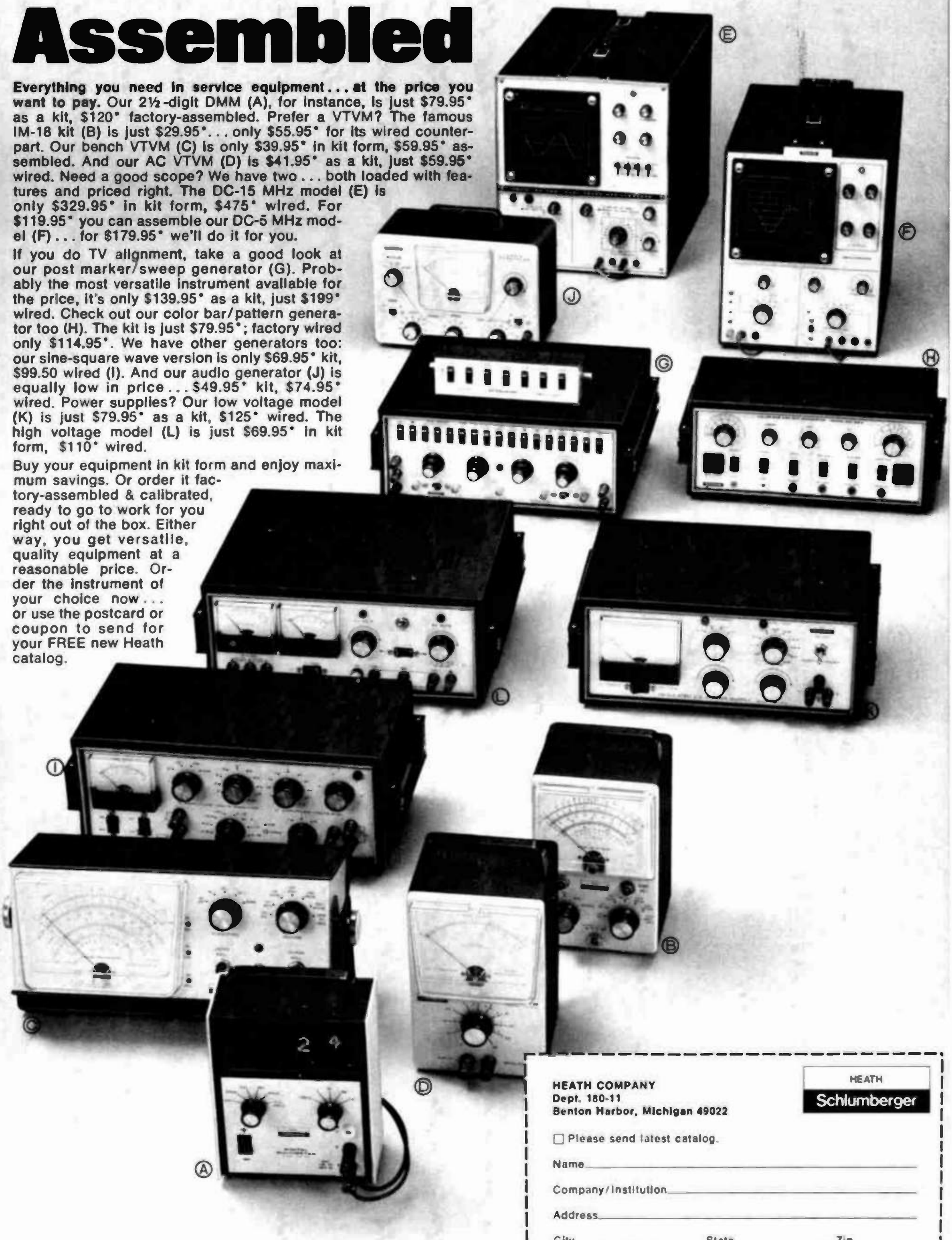
ARIZ.: Phoenix; CALIF.: Anaheim, El Cerrito, Los Angeles, Pomona, Redwood City, San Diego (La Mesa), Woodland Hills; COLO.: Denver; CONN.: Hartford (Avon); FLA.: Miami (Hialeah), Tampa; GA.: Atlanta; ILL.: Chicago, Downers Grove; IND.: Indianapolis; KANSAS: Kansas City (Mission); KY.: Louisville; LA.: New Orleans; MD.: Baltimore, Rockville; MASS.: Boston (Wellesley); MICH.: Detroit; MINN.: Minneapolis (Hopkins); MO.: St. Louis; N.J.: Fair Lawn; N.Y.: Buffalo (Amherst), New York City, Jericho, L.I.: Rochester, White Plains; OHIO: Cincinnati (Woodlawn), Cleveland, Columbus; PA.: Philadelphia, Pittsburgh; R.I.: Providence (Warwick); TEXAS: Dallas, Houston; WASH.: Seattle; WIS.: Milwaukee.

Assembled

Everything you need in service equipment . . . at the price you want to pay. Our 2½-digit DMM (A), for instance, is just $79.95* as a kit, $120* factory-assembled. Prefer a VTVM? The famous IM-18 kit (B) is just $29.95* . . . only $55.95* for its wired counterpart. Our bench VTVM (C) is only $39.95* in kit form, $59.95* assembled. And our AC VTVM (D) is $41.95* as a kit, just $59.95* wired. Need a good scope? We have two . . . both loaded with features and priced right. The DC-15 MHz model (E) is only $329.95* in kit form, $475* wired. For $119.95* you can assemble our DC-5 MHz model (F) . . . for $179.95* we'll do it for you.

If you do TV alignment, take a good look at our post marker/sweep generator (G). Probably the most versatile instrument available for the price, it's only $139.95* as a kit, just $199* wired. Check out our color bar/pattern generator too (H). The kit is just $79.95*; factory wired only $114.95*. We have other generators too: our sine-square wave version is only $69.95* kit, $99.50 wired (I). And our audio generator (J) is equally low in price . . . $49.95* kit, $74.95* wired. Power supplies? Our low voltage model (K) is just $79.95* as a kit, $125* wired. The high voltage model (L) is just $69.95* in kit form, $110* wired.

Buy your equipment in kit form and enjoy maximum savings. Or order it factory-assembled & calibrated, ready to go to work for you right out of the box. Either way, you get versatile, quality equipment at a reasonable price. Order the instrument of your choice now . . . or use the postcard or coupon to send for your FREE new Heath catalog.



For More Details Circle (10) on Reply Card

HEATH COMPANY
Dept. 180-11
Benton Harbor, Michigan 49022

HEATH
Schlumberger

☐ Please send latest catalog.

Name_____

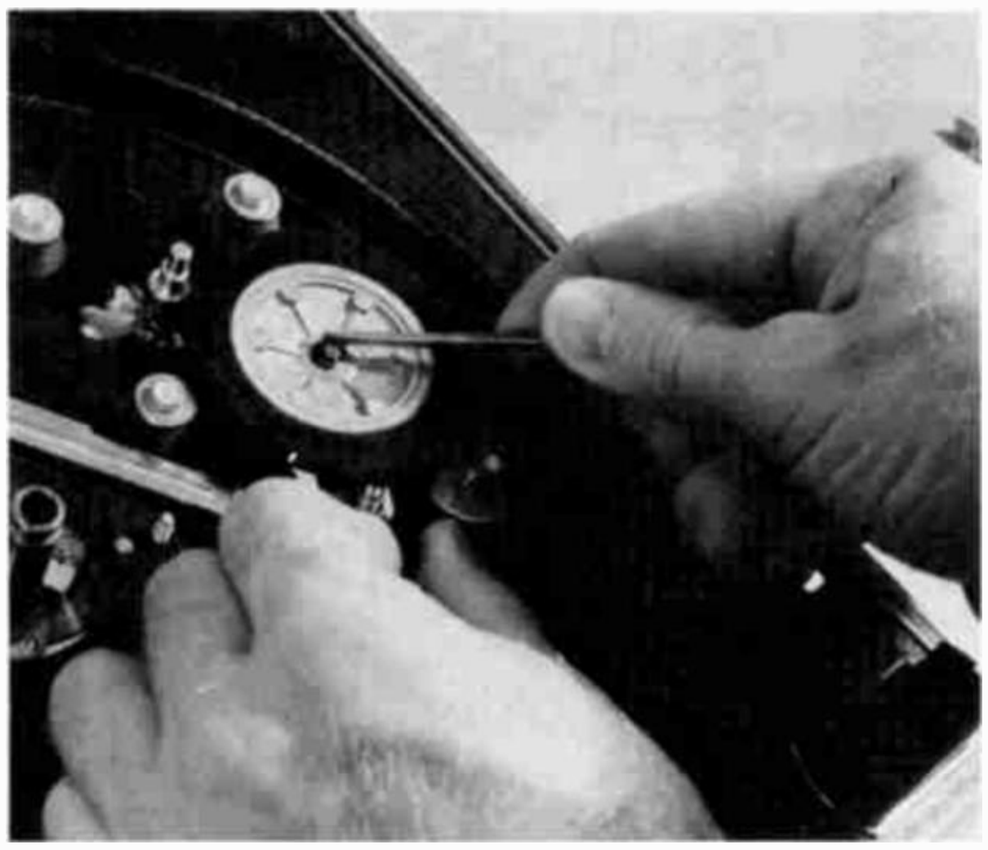
Company/Institution_____

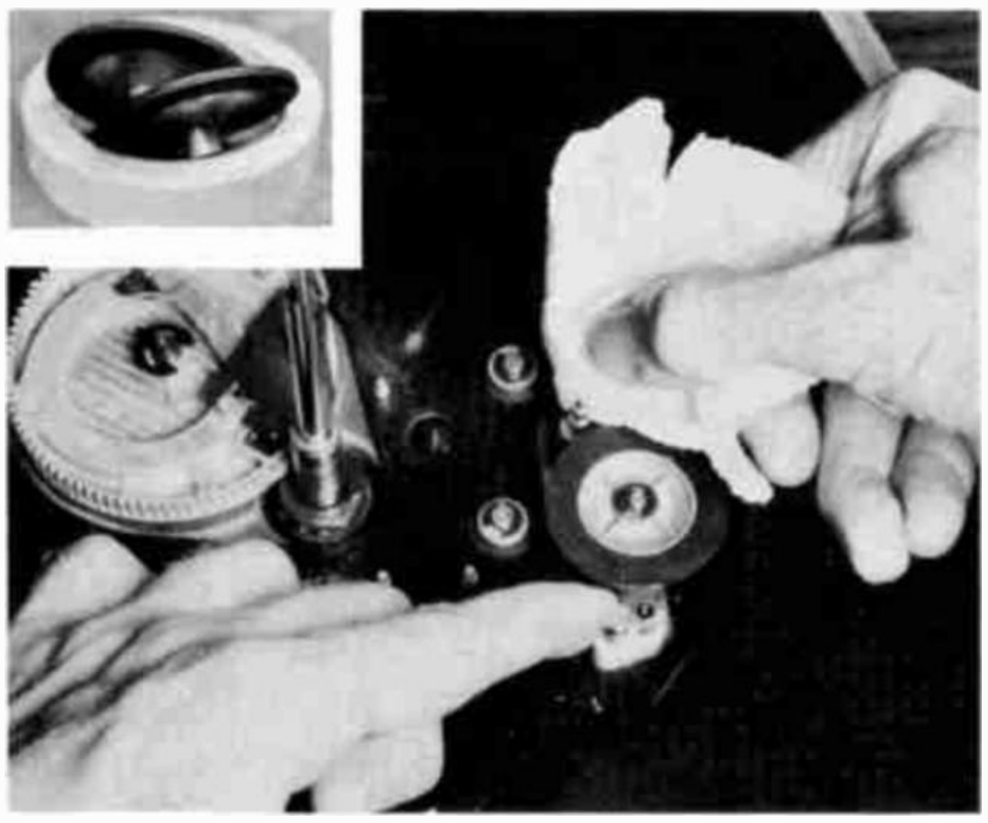
Address_____

City_____ State_____ Zip_____

*Mail order prices; FOB factory TE-295

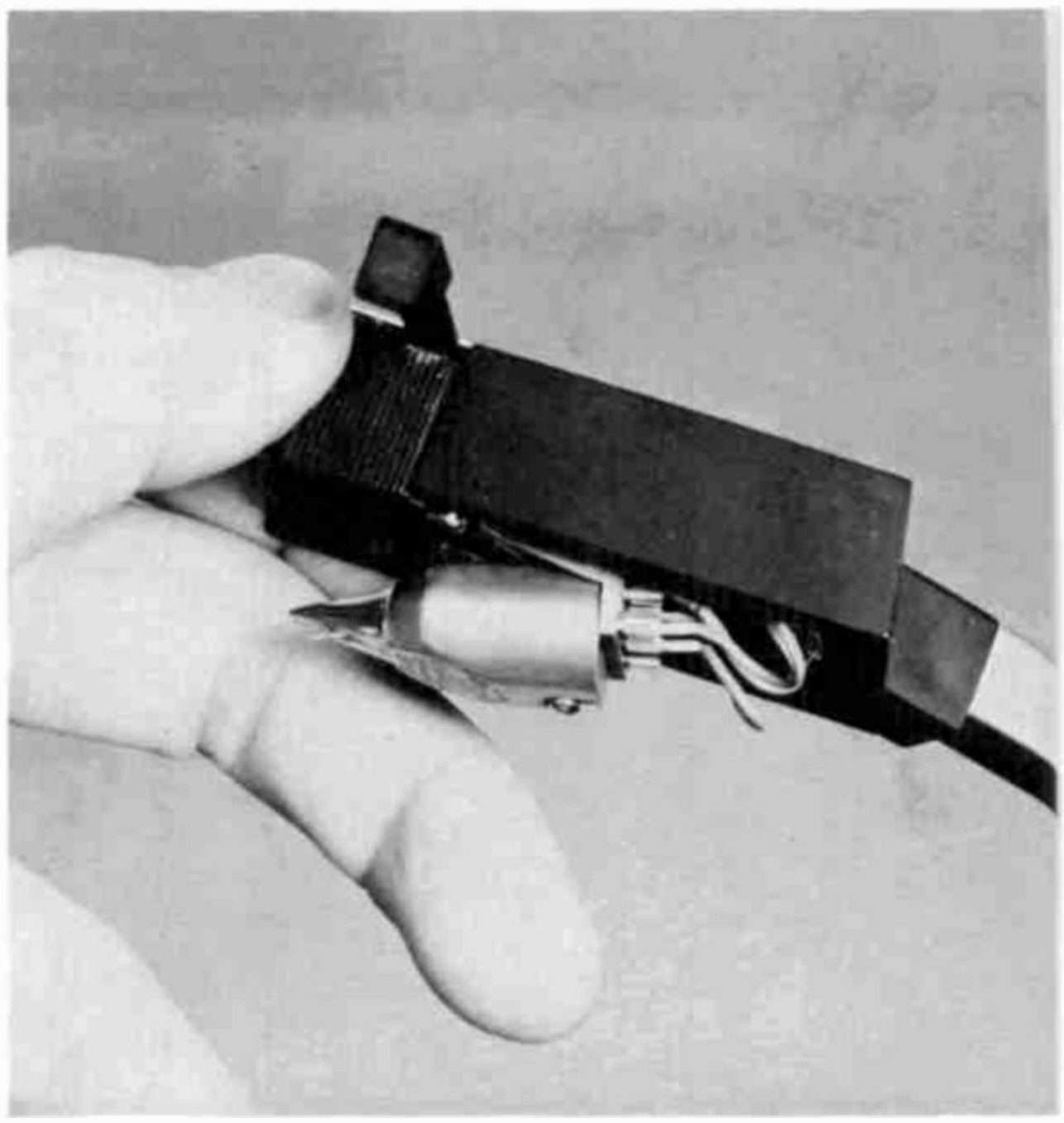
(Continued from page 15)



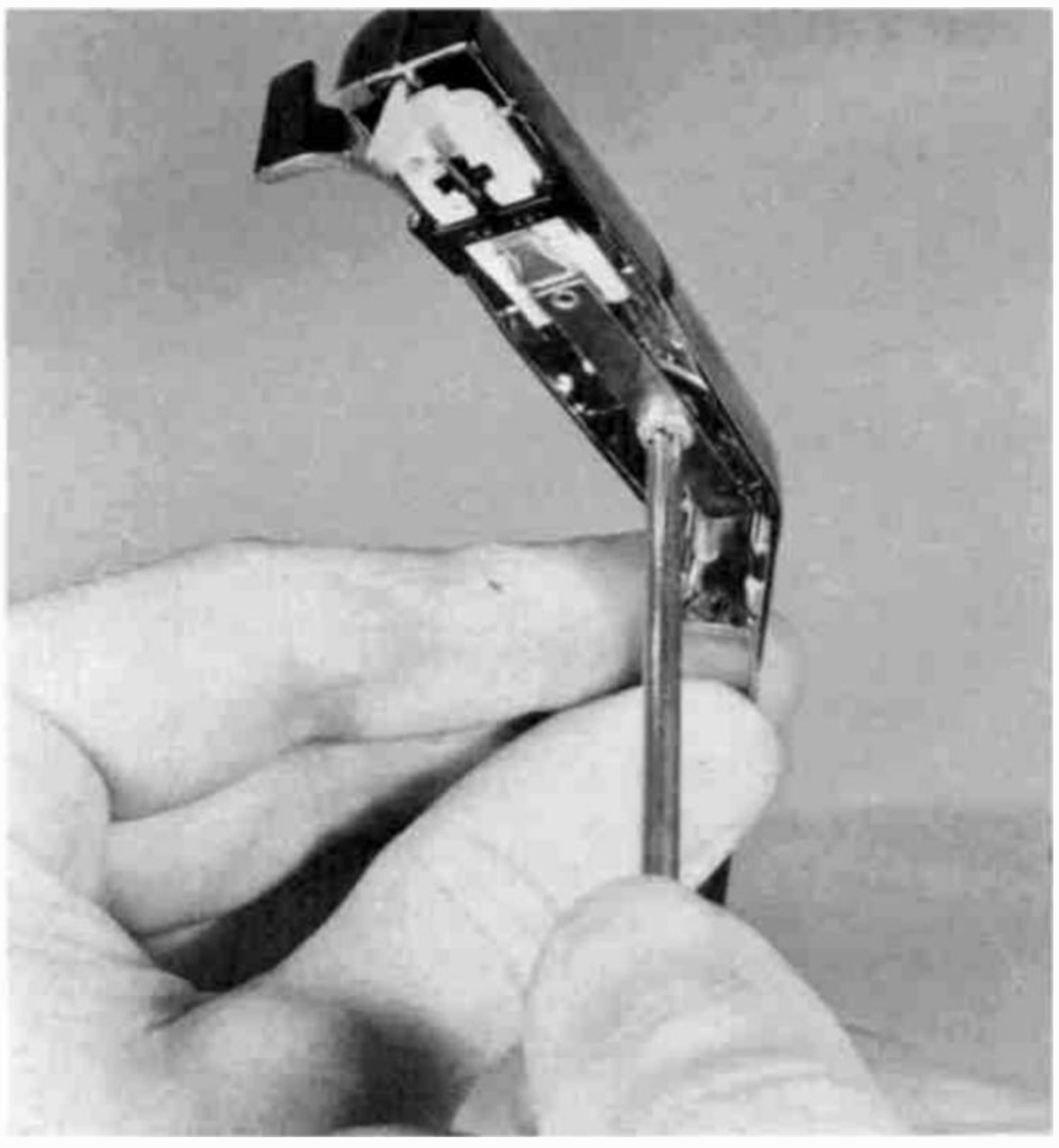


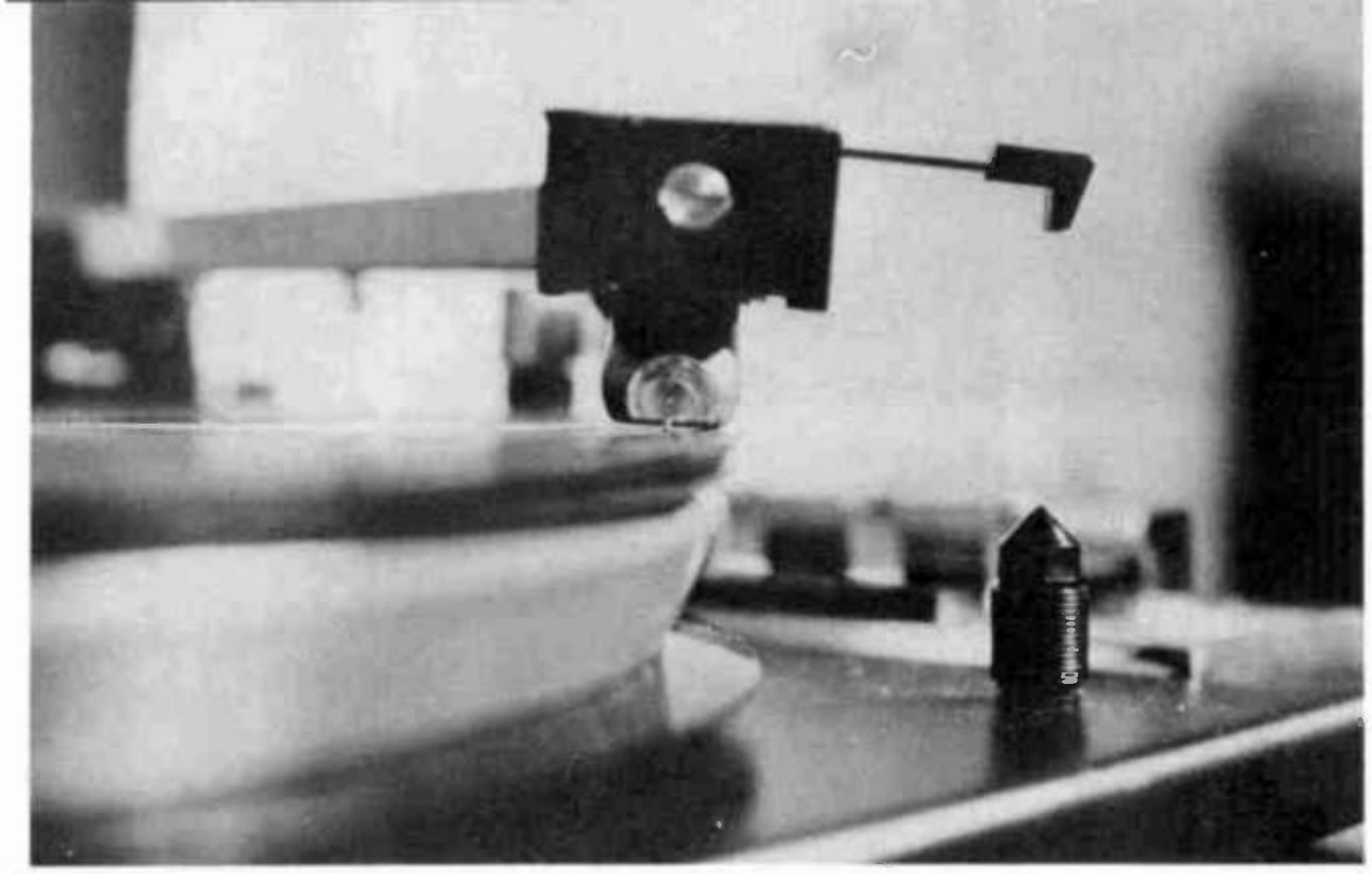
Step 4. An equally-important cleaning job involves the pulley on the motor and the rubber-tired drive idler. Hold an alcohol-soaked wiper in contact with the spinning motor pulley. Be sure you get into the crevices on each step of the pulley. Don't clean the idler that way, though. Remove it and wipe thoroughly with alcohol, keeping fingers away from the drive rubber. Take a close look at the surface of the tire. Any almost invisible lump can cause thumping and wow in sound from a record. If the rubber surface has a glazed or "shadowed" look, replace the idler (it costs less than a callback). Don't touch the rubber surface or let it touch anything as you replace the idler on its mounting.

Step 6. Make sure the cartridge mounting is tight. Complaints of an erratic channel originate often from faulty cartridge mounting. Particularly suspect the kind that "snap" into the end of the tone arm; the leaf-spring metal contactors notoriously make poor contact. Before you take a cartridge loose, check the wiring at the rear; sketch a diagram to prevent miswiring in case wires slip off or break.

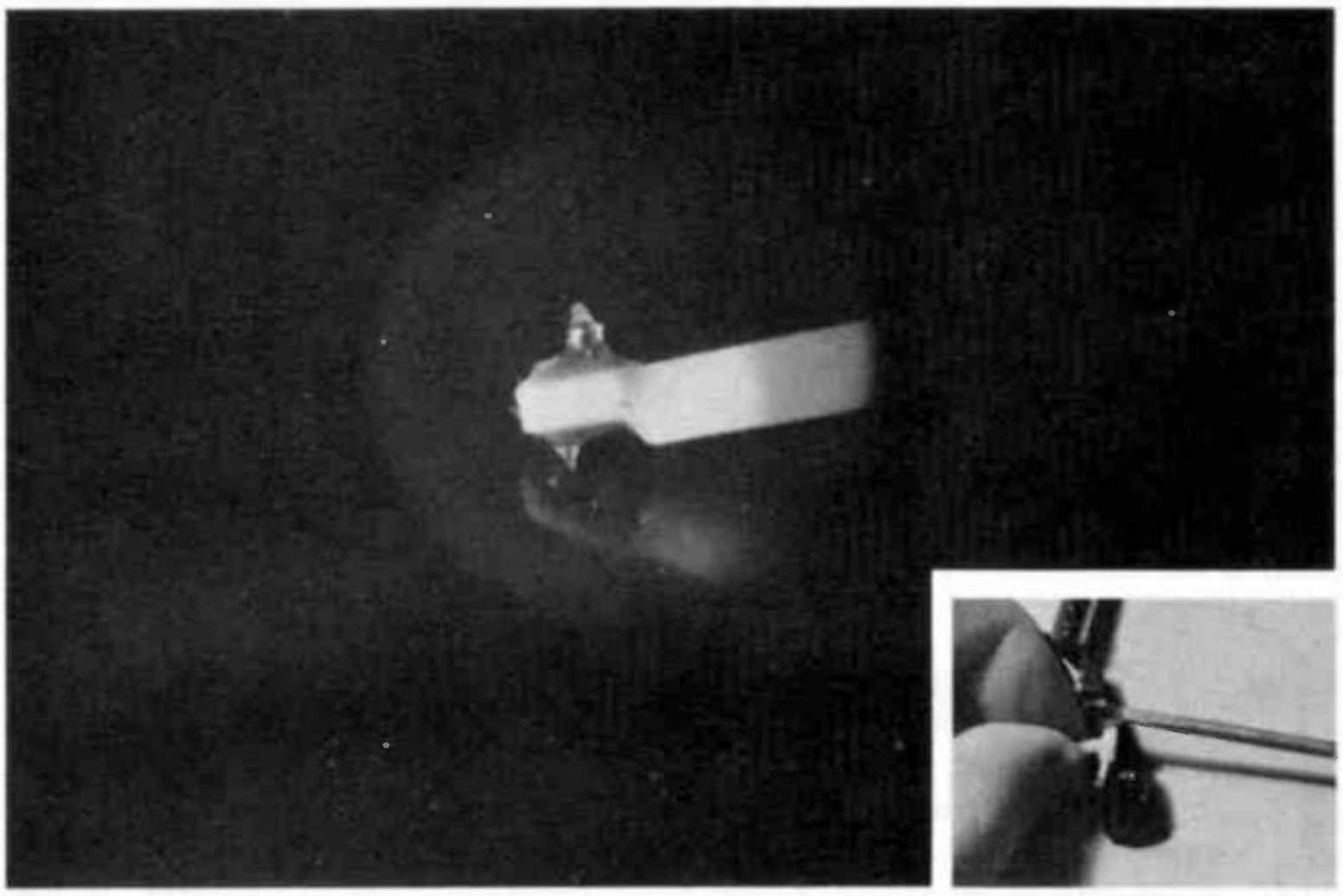


Step 5. Make some preliminary tests before checking out the mechanism. The "scrape" test verifies that the cartridge works. With stereo cartridges, listen to both channels. Scrape the ridges of your fingertip **LIGHTLY** across the stylus tip; carelessness could damage cartridge and stylus.

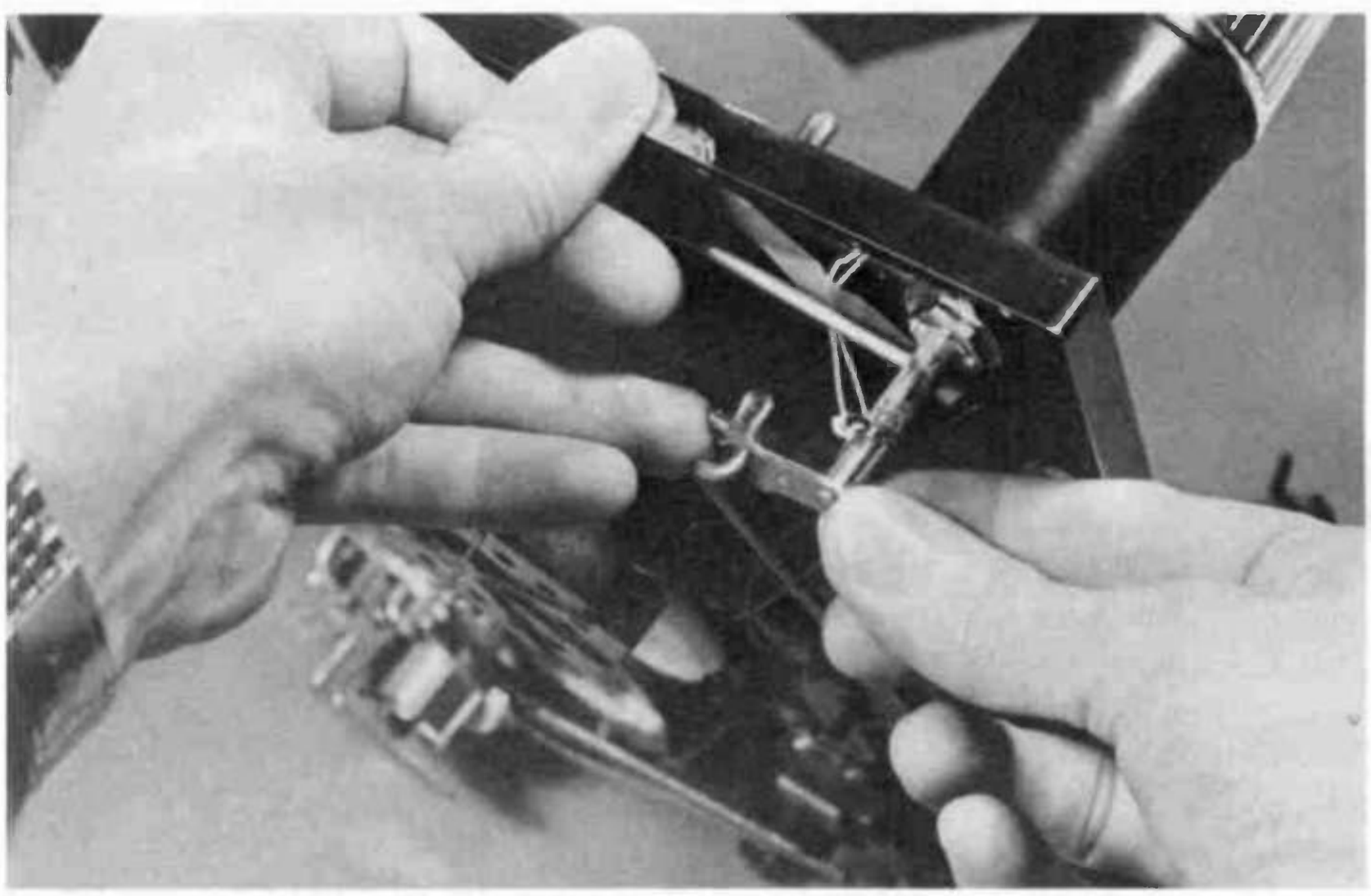


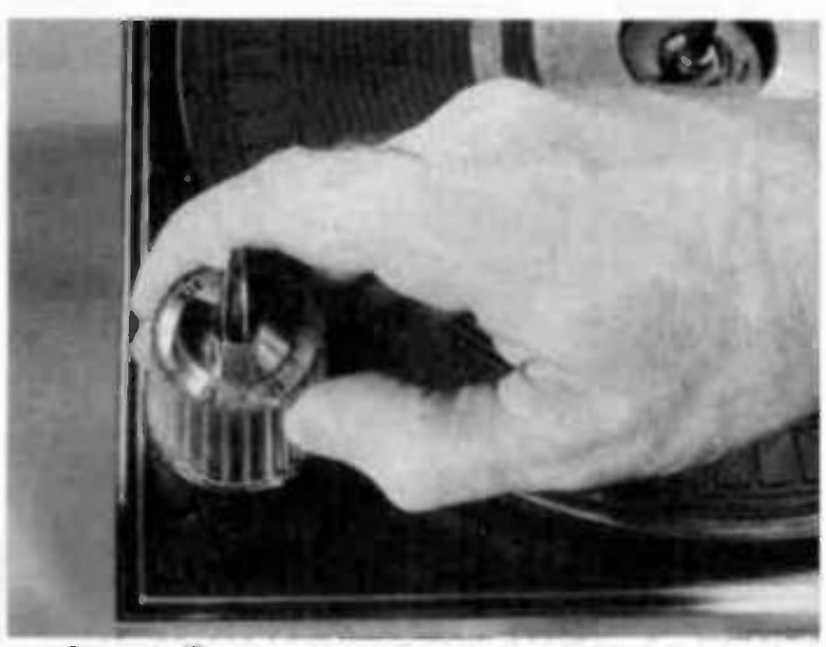


Step 7. Inspect the cartridge mounting for vertical tracking error. The bottom of the cartridge should be precisely parallel with the platter (or record) surface. In some high-quality turntables, this is adjustable. Where it isn't, find a way to correct any error. The needle rides poorly in the record groove if you leave it slanting, and distortion and record wear are high.

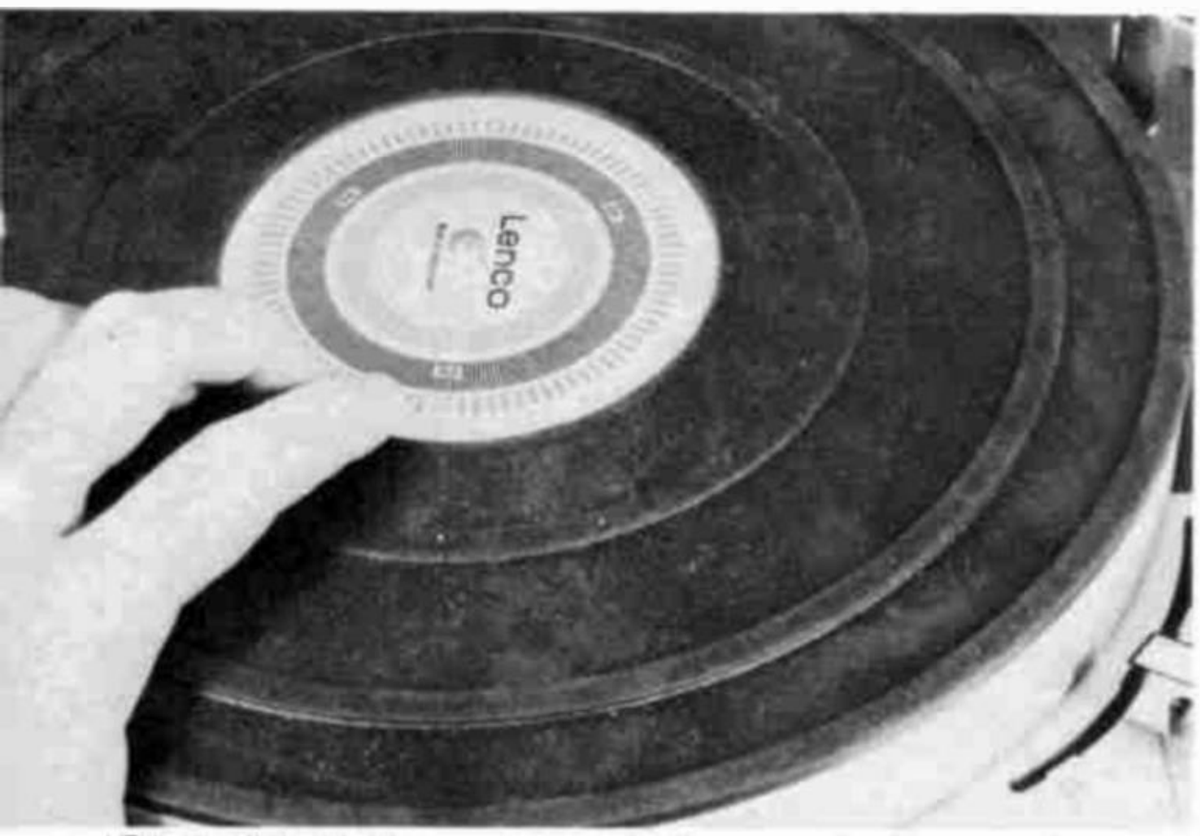


Step 8. The "scrape" test tells nothing about stylus quality. In fact, your ear can't be trusted either. Inspect the stylus tip under a microscope. You can buy a small hand-held microscope for this inspection. Sapphire tips can be expected to cause record wear after 25 hours of playing. Diamonds are okay to 500 hours, but should be inspected every 100 hours after that.

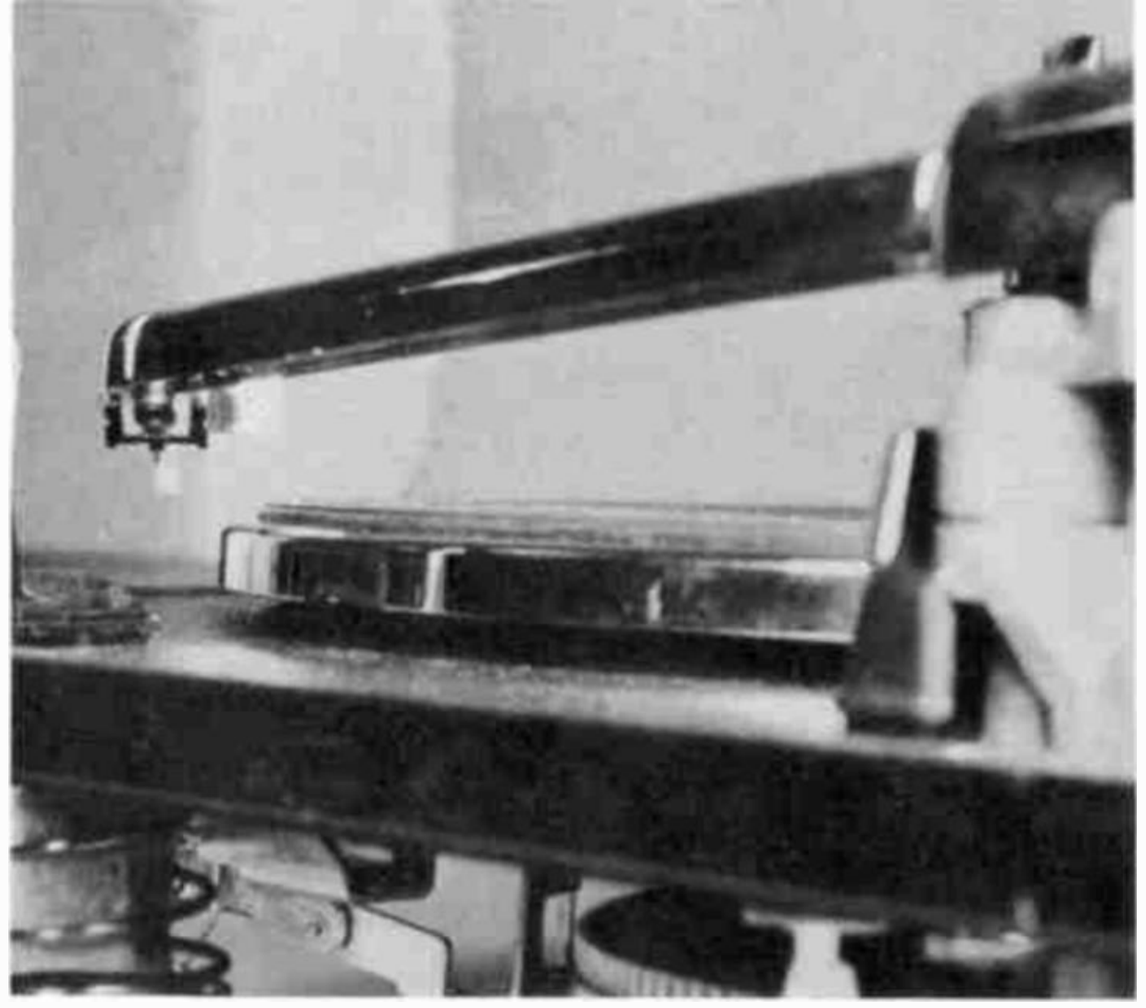




Step 9. As part of your inspection, try all controls. Check their freedom of action. Inspect underneath; make sure no linkages or springs are off. Usually, the above-deck controls include on-off-reject and speed, sometimes size indexing and cueing. In your first operational tryout of the machine, see if they do what they're supposed to.

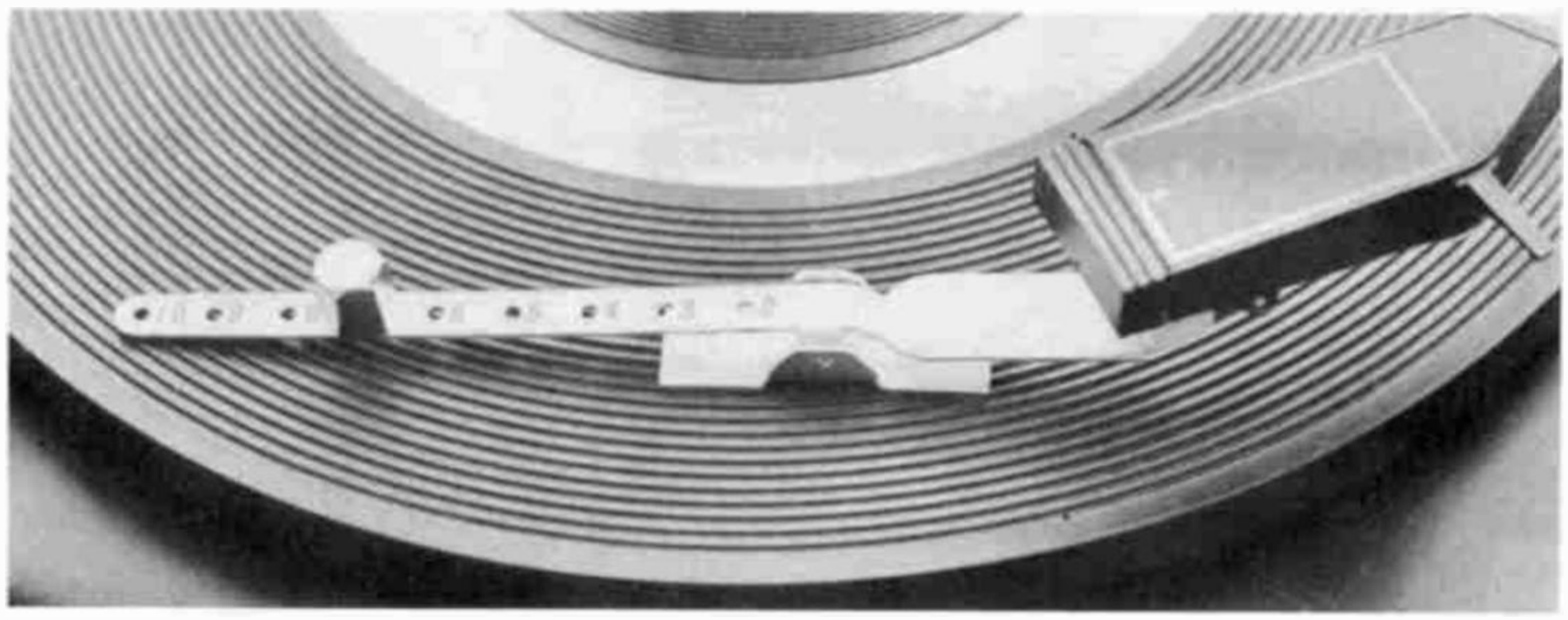


Step 10. Verify accuracy of the speeds. Strobe discs are inexpensive. Under 60-Hz light, the marks "stand still" if speed is accurate. Constancy of speed is more important than accuracy. If the marks appear to move erratically or with a swinging motion, the machine cannot deliver hi-fi sound. The cure may lie in the drive system, the platter may have become unbalanced, or hub bearings may need replacing.

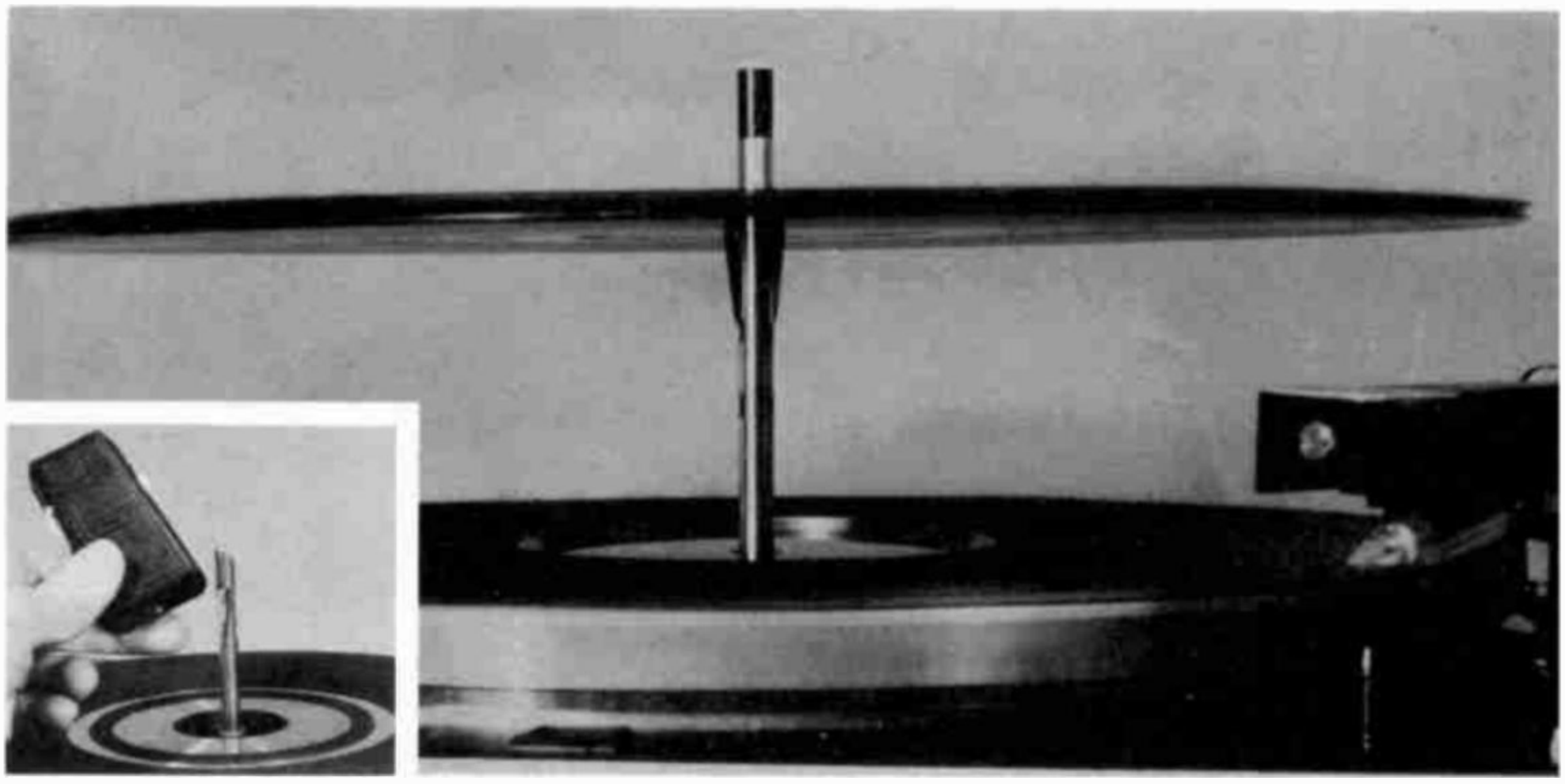


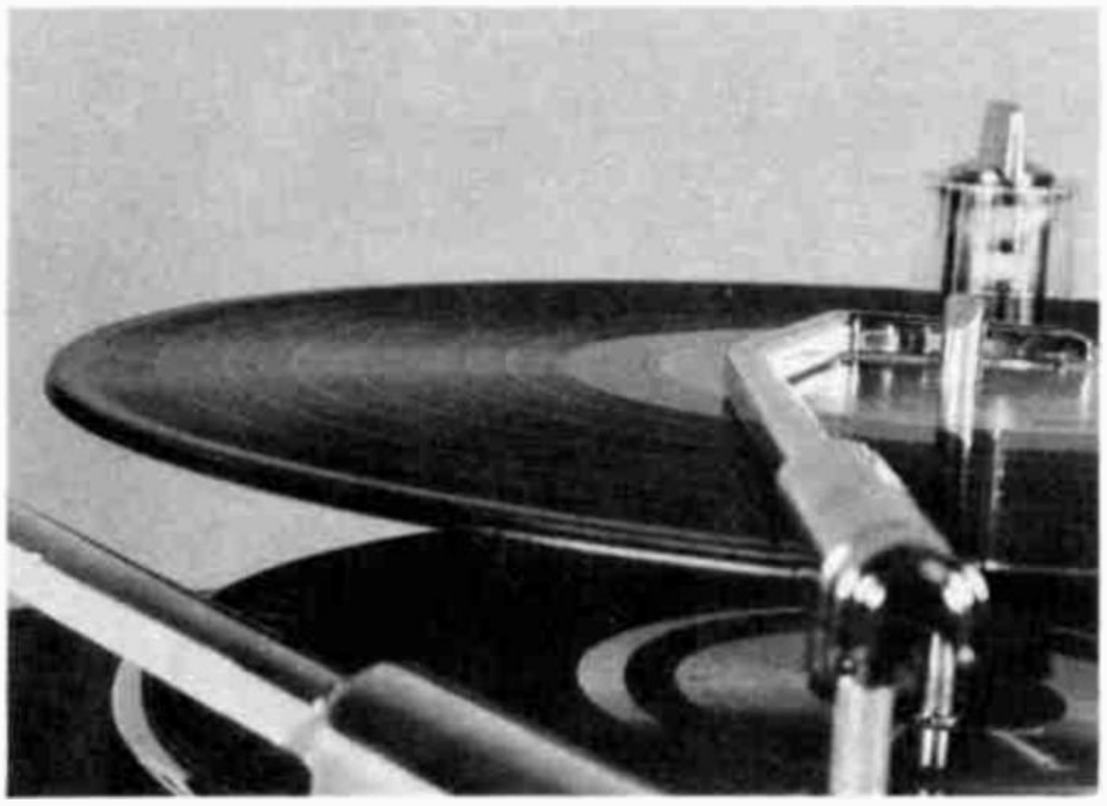
Tone arm balance is important, because that's the starting point for setting grams of stylus pressure. As you'll see in the next Workshop session, you begin at zero grams, the balance point. Then you test to verify what the pressure knob says.

Step 11. Inexpensive changers don't have a stylus-pressure knob. Instead, you set pressure with an adjustable spring, and use a scale for "weighing" the tone arm at the stylus. Some experts prefer the gram gauge down beside the platter, others insist it's more accurate with the tone arm up where it plays.

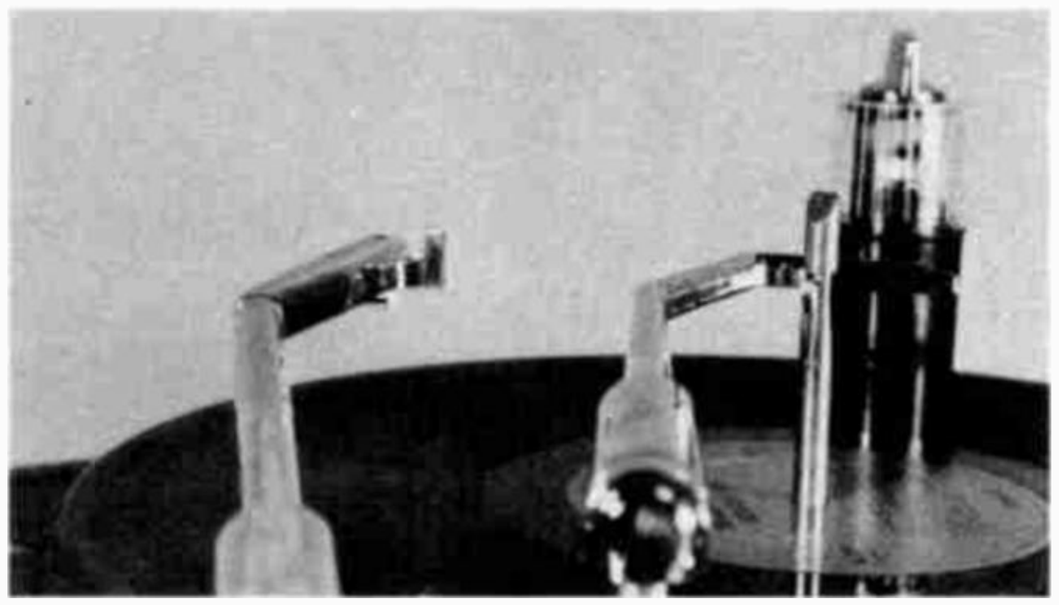


Step 12. Test record dropping, with regular spindle and with 45-RPM. Pay particular attention to how far the pushoff tab moves out and back. In some automatic turntables, this has an extra purpose: sensing when there's no record left, to trigger automatic shutoff. Spindles for changers or turntables should be replaced when one doesn't function right, as long as you're sure the fault isn't down below in the slide mechanism.

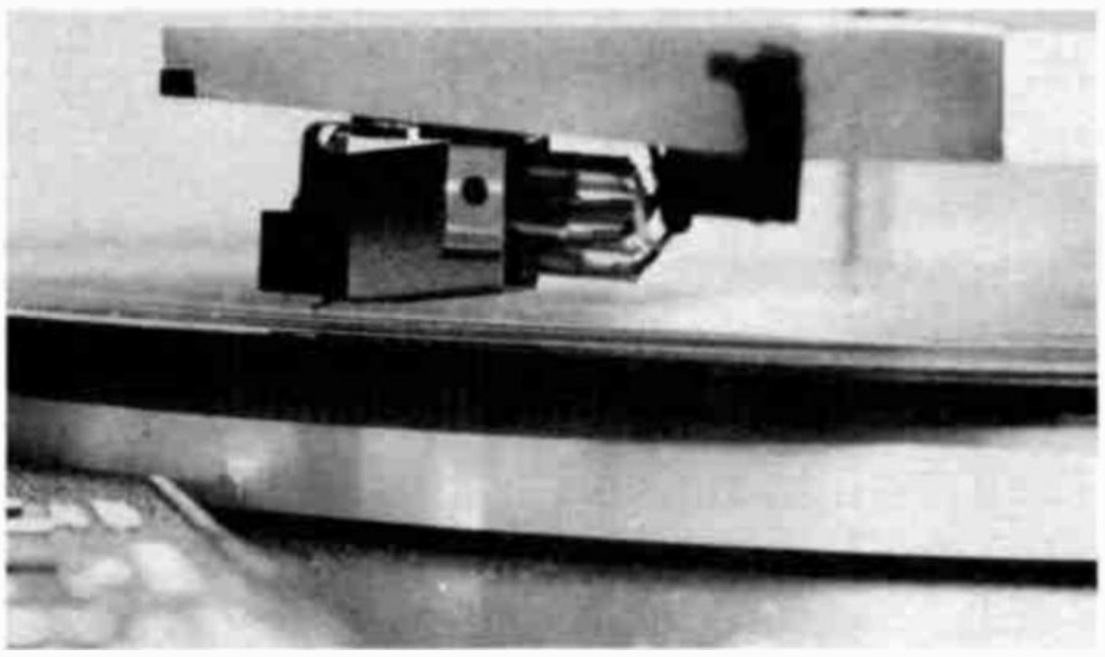




Step 13. Test the lift height. The tone arm must raise high enough to clear a sensible number of records on the platter—no more than six for best fidelity. The arm must also NOT go so high as to bump the record stack on the spindle. Check both heights.



Step 14. Test automatic tripping. That is, put the stylus down near the center, carefully. Let the record play out and see if the change cycle initiates as it should. One mechanism underneath lets the tone arm trip the cycle from the lead-out groove; another is for "reject" or initiating the cycle manually.



Step 15. Test setdown. Though indexing may be correct, stopping the tone arm at approximately the right diameter, you might have to refine the setdown adjustment to hit the first groove exactly. At best, this may involve a compromise among the three record sizes. If a compromise won't work, chances are the indexing system is worn and needs repair or parts replacement.

Next Month

As I promised at the beginning of this session, you've been exposed to those parts of a record changer or automatic turntable you need to check first, before you proceed with diagnosis. You've learned a general, basic approach to servicing a changer or turntable.

The next session takes you further, to the next major step in your approach. You'll see how to set most of the adjustments on major brands of changers and hi-fi turntables. There are variations, and several are shown. Then, in two later Workshop sessions, I'll explain the intricacies of mechanisms and of diagnosis.

Step 16. Test cue damping, if the turntable you're servicing has it. Damping lets the tone arm lower gently, even though you pull the cue lever down quickly. A mechanism underneath slows the descent, usually by friction. Too quick or too slow means you'll have to check the mechanism.

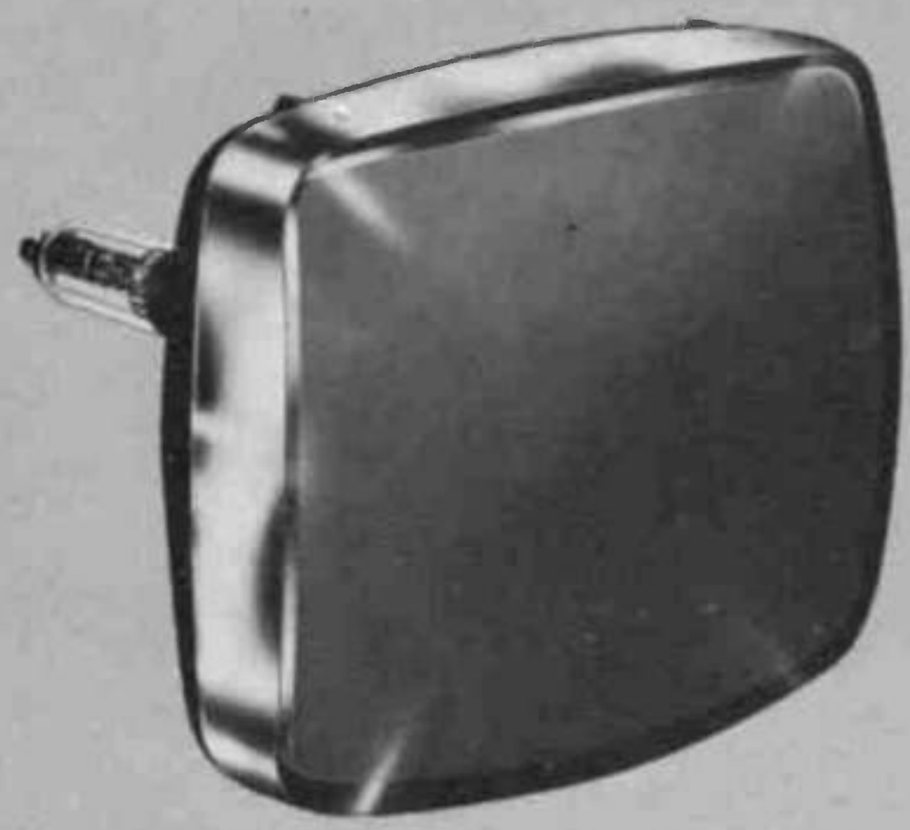
Now–a middle line of RCA replacement color picture tubes...

COLORAMA

INTRODUCING RCA COLORAMA A

It rounds out RCA's complete range of tube quality, price and warranties.

HI-LITE

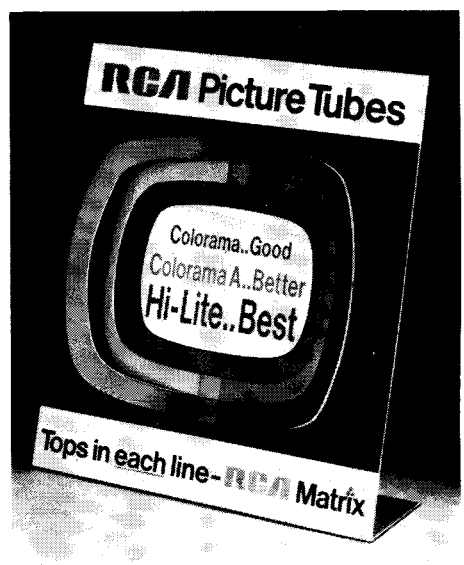


Colorama...Good
This is RCA's commercial standard color picture tube line. Each tube has a new electron gun. The other components and materials are re-used, after careful inspection to meet RCA's high quality standards. 12 month warranty...additional 12 months available.

Colorama A...Better
This is RCA's grade "A" line. Every tube is totally remanufactured using the latest all-new rare earth phosphors, new electron gun, and used X-radiation attenuation glass. 18 month warranty...additional 12 months available.

Hi-Lite...Best
This is RCA's prestige line of all-new color picture tubes. Each incorporates a new electron gun, new X-radiation attenuation glass, latest new rare earth phosphors and Perma-Chrome, for locked-in color purity and uncompromised contrast and brightness. 24 month warranty...additional 12 months available.

And all three lines include RCA BLACK MATRIX Types, the advanced RCA tubes that are as much as 100% brighter than any equivalent non-Matrix picture tube in RCA's history. So get the full choice of color picture tube quality, price and warranties. Make your choice RCA, leader in electronics for the home.



RCA

RCA/Electronic Components/Harrison, N.J. 07029

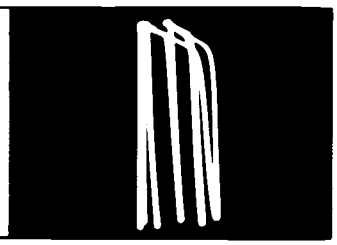
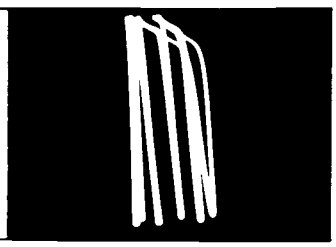
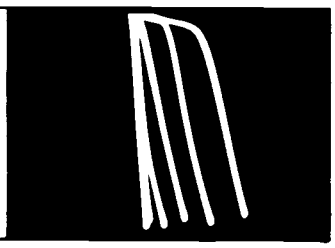
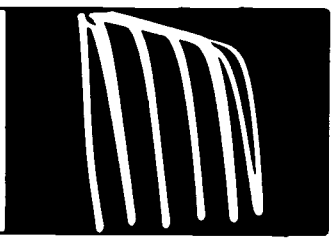
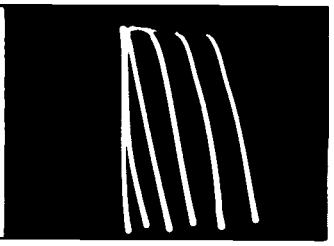
For More Details Circle (36) on Reply Card

SIGNATURE PATTERNS

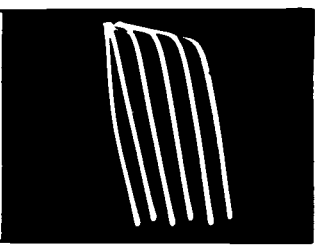
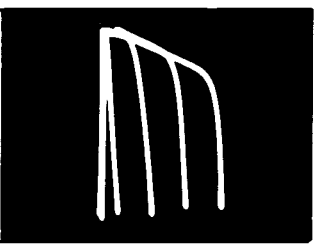
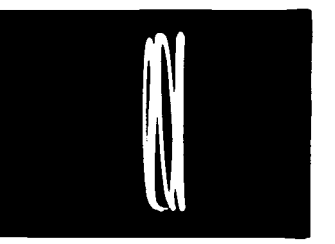
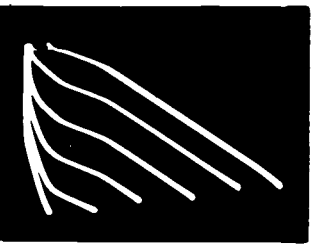
Made On Jud Williams Model A Curve Tracer

GENERAL ELECTRIC CHASSIS 25MA

MANUFACTURER	MODEL OR CHASSIS
GENERAL ELECTRIC	25MA

TRANSISTOR IDENTIFICATION & CURVE TRACER SETTINGS	SIGNATURE PATTERNS
Q201 3rd IF POLARITY NPN SWEEP VOLTAGE 30V BASE CURRENT 200uA	
Q202 4th IF POLARITY NPN SWEEP VOLTAGE 30V BASE CURRENT 200uA	
Q203 1st VID POLARITY NPN SWEEP VOLTAGE 30V BASE CURRENT 50uA	
Q204 2nd VID POLARITY NPN SWEEP VOLTAGE 30V BASE CURRENT 100uA	
Q206 4.5MHz DET POLARITY NPN SWEEP VOLTAGE 30V BASE CURRENT 50uA	

MANUFACTURER	MODEL OR CHASSIS
GENERAL ELECTRIC	25MA

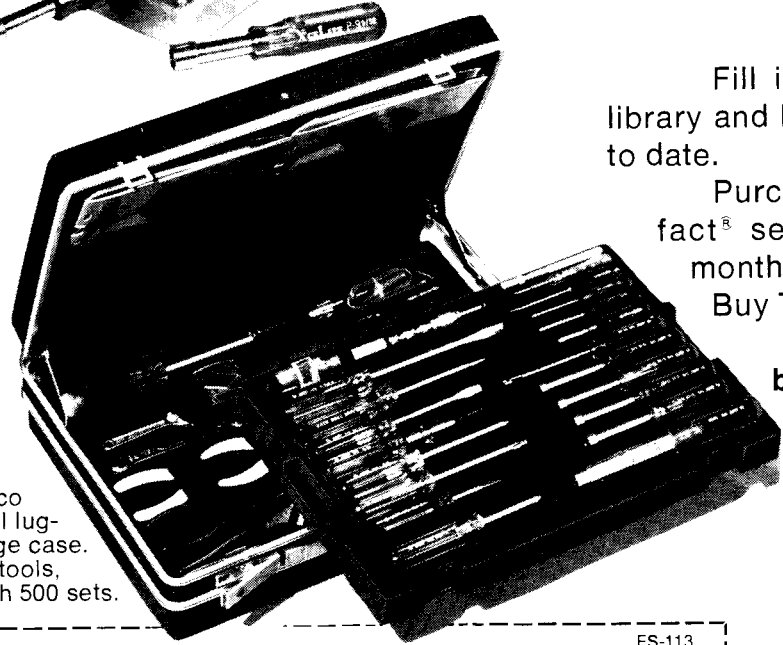
TRANSISTOR IDENTIFICATION & CURVE TRACER SETTINGS	SIGNATURE PATTERNS
Q207 AGC INV POLARITY NPN SWEEP VOLTAGE 30V BASE CURRENT 50uA	
Q208 AUX AMP POLARITY NPN SWEEP VOLTAGE 30V BASE CURRENT 50uA	
Q301 DELAY LINE DRIVER POLARITY NPN SWEEP VOLTAGE 30V BASE CURRENT 200uA	
Q302 VID POLARITY PNP SWEEP VOLTAGE 30V BASE CURRENT 50uA	
Q303 1st VID POLARITY NPN SWEEP VOLTAGE 30V BASE CURRENT 10uA	

(Continued on page 28)

"Easy Buy" time payment plan for Sams Photofact®

Free tool set if you act now!

PS130 Xcelite screwdriver, nutdriver set, with 60 sets.



Vaco tool luggage case. 33 tools, with 500 sets.

Fill in the gaps in your Photofact® library and bring your service coverage up to date.

Purchase a minimum of 60 Photofact® sets and pay for them in easy monthly installments through the Easy Buy Time Payment Plan.

If you act now you get a bonus. Choice of tool sets FREE, with orders of 60, 180, 300 or 500 Photofact® sets!

And, as usual, you can get a single drawer file cabinet for $4.00 with every 60 sets, or a 4-drawer file cabinet for $15.00 with every 180 sets.

But act now and send for your Easy Buy order form. Bonus offer expires December 31, 1973.

ES-113

HOWARD W. SAMS & CO., INC.
4300 West 62nd Street, Indianapolis, Indiana 46268

Please send me Photofact Coverage Chart, Easy Buy order form and bonus tool offer.

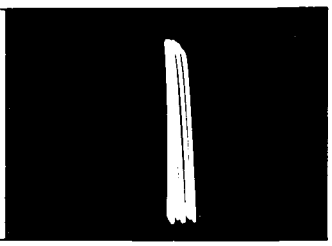
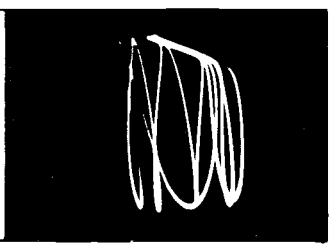
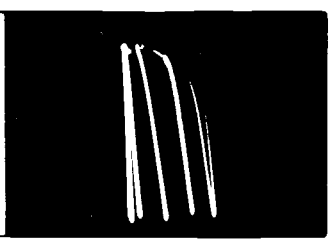
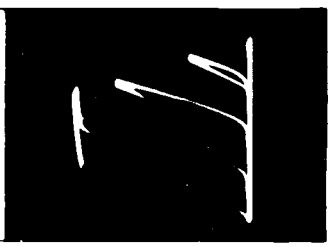
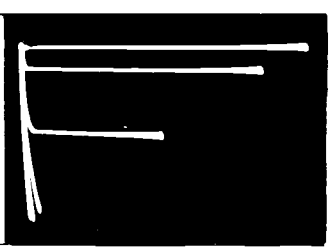
Name_____

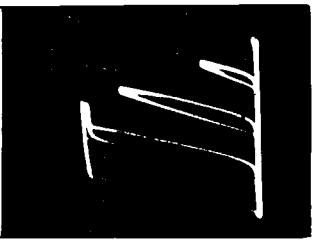
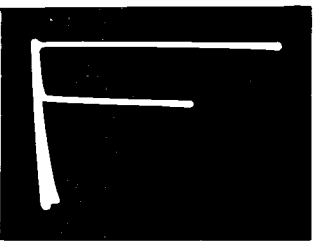
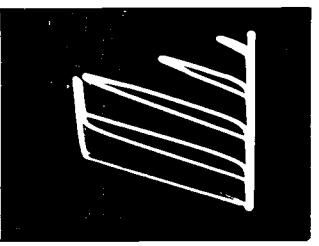
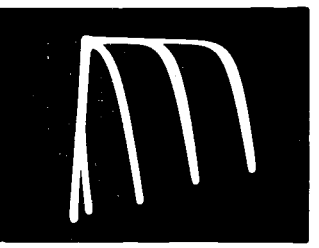
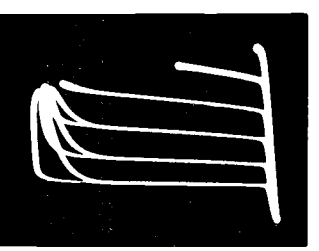
Address_____

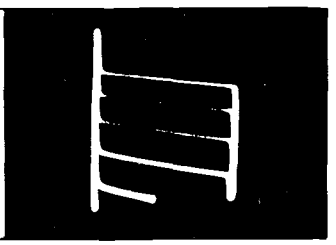
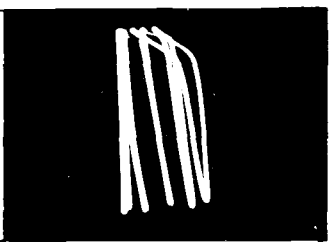
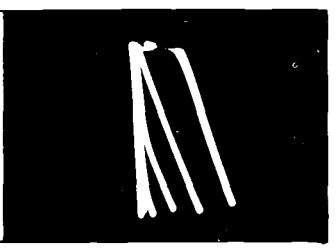
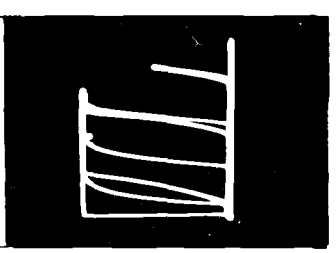
City_____ State_____ Zip_____

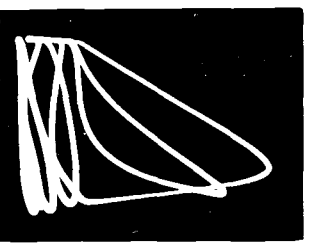
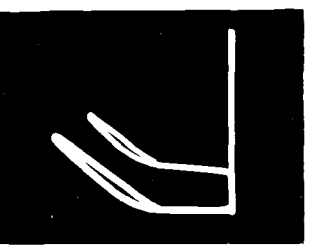
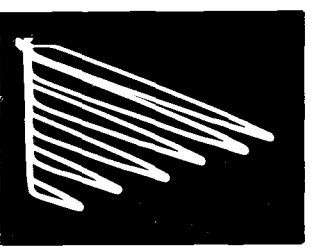
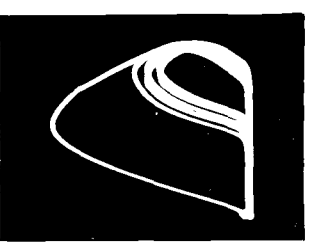
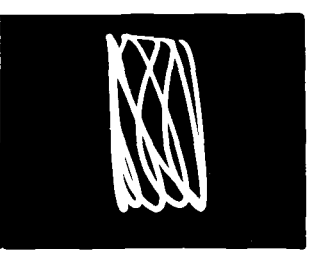
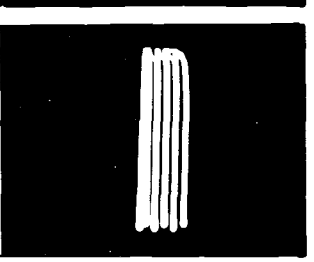
For More Details Circle (27) on Reply Card

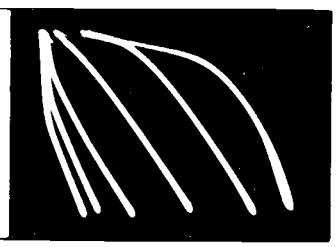
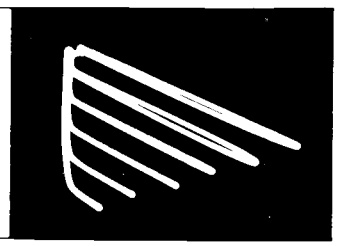
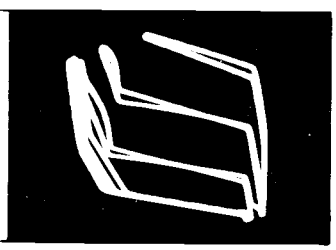
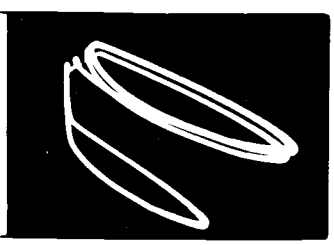
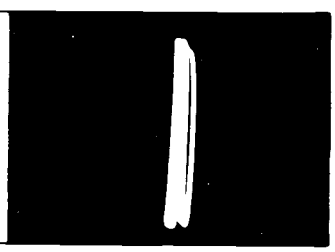
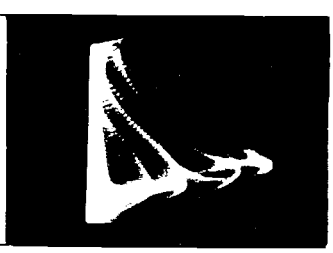
(Continued from page 26)

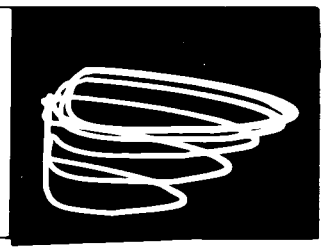
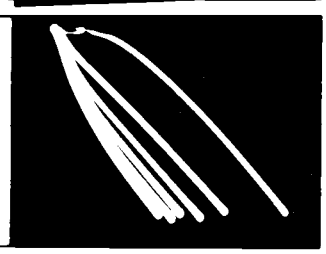
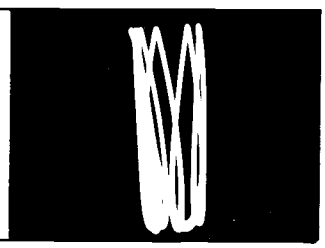
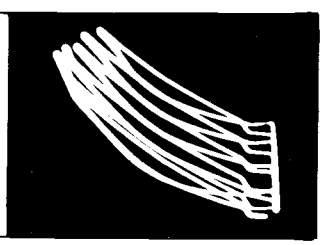
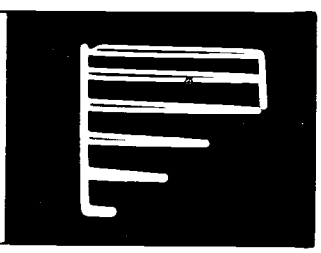
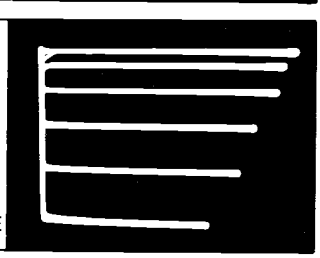
MANUFACTURER GENERAL ELECTRIC	MODEL OR CHASSIS 25MA
TRANSISTOR IDENTIFICATION & CURVE TRACER SETTINGS	**SIGNATURE PATTERNS**
Q304 2nd VID **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 100uA	
Q305 VIDEO OUTPUT **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 100uA	
Q306 BRITE **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 20uA	
Q307 BEAM LIMITER **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 500uA	
Q402 RED **POLARITY** PNP **SWEEP VOLTAGE** 30V **BASE CURRENT** 20uA	
Q403 RED OUTPUT **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 100uA	

MANUFACTURER GENERAL ELECTRIC	MODEL OR CHASSIS 25MA
TRANSISTOR IDENTIFICATION & CURVE TRACER SETTINGS	**SIGNATURE PATTERNS**
Q404 GRN **POLARITY** PNP **SWEEP VOLTAGE** 30V **BASE CURRENT** 20uA	
Q405 GRN OUTPUT **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 100uA	
Q406 BLUE **POLARITY** PNP **SWEEP VOLTAGE** 30V **BASE CURRENT** 20uA	
Q407 BLUE OUTPUT **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 100uA	
Q501 AUDIO DRIVER **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 500uA	
Q502 AUDIO OUTPUT **POLARITY** PNP **SWEEP VOLTAGE** 30V **BASE CURRENT** 10 uA	

MANUFACTURER GENERAL ELECTRIC	MODEL OR CHASSIS 25MA
TRANSISTOR IDENTIFICATION & CURVE TRACER SETTINGS	**SIGNATURE PATTERNS**
Q503 AUDIO OUTPUT **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 10uA	
Q600 CHROMA PRE AMP **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 100 uA	
Q601 VOLT REG **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 50uA	
Q602 PHASE SHIFT **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 50uA	
Q700 VERT OSC **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 20uA	
Q701 VERT OSC **POLARITY** PNP **SWEEP VOLTAGE** 30V **BASE CURRENT** 20uA	

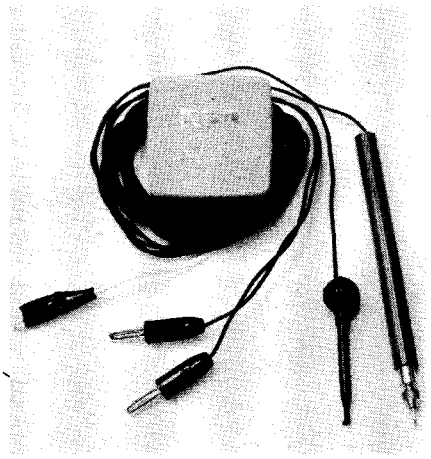
MANUFACTURER GENERAL ELECTRIC	MODEL OR CHASSIS 25MA
TRANSISTOR IDENTIFICATION & CURVE TRACER SETTINGS	**SIGNATURE PATTERNS**
Q703 DIFF PAIR **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 20uA	
Q704 VERT DRIVER **POLARITY** PNP **SWEEP VOLTAGE** 30V **BASE CURRENT** 200uA	
Q705 VERT OUTPUT **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 20uA	
Q706 VERT OUTPUT **POLARITY** PNP **SWEEP VOLTAGE** 30V **BASE CURRENT** 20uA	
Q707 DIFF PAIR **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 20uA	
Q901 VOLT REG **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 500uA	

MANUFACTURER GENERAL ELECTRIC	MODEL OR CHASSIS 25MA
TRANSISTOR IDENTIFICATION & CURVE TRACER SETTINGS	**SIGNATURE PATTERNS**
Q1001 SYNC AMP **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 20uA	
Q1003 SYNC SEP **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 10uA	
Q1004 NOISE CANC **POLARITY** PNP **SWEEP VOLTAGE** 30V **BASE CURRENT** 20uA	
Q1005 RAMP GEN **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 50uA	
Q1006 REACTANCE **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 200uA	
Q1007 HORIZ OSC **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 10uA	

MANUFACTURER GENERAL ELECTRIC	MODEL OR CHASSIS 25MA
TRANSISTOR IDENTIFICATION & CURVE TRACER SETTINGS	**SIGNATURE PATTERNS**
Q1101 HORIZ BUFFER **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 20uA	
Q1301 AMP **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 50uA	
Q1302 ERROR AMP **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 500uA	
Q1304 OVERLOAD DET **POLARITY** PNP **SWEEP VOLTAGE** 30V GATE VOLTAGE IV PER STEP (INVERTED)	
Q1701 HORIZ OUTPUT **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 100uA UNPLUG BUFFER MODULE	
Q1702 HIGH VOLT REG **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 100uA UNPLUG HV REG MODULE	

A practical method of "QUICKTESTING" transistors

By Bruce Anderson



The RCA WC528C "Quicktracer" plugs into a 120-volt outlet, the alligator clip connects to the scope vertical probe, and banana plugs connect to scope horizontal input and ground. The clip-on probe is ground (connects to transistor base), and the needle probe is hot (connects to emitter or collector).

Table 1

Brands of junction curve tracers, and when covered in Electronic Servicing

- Advanced Applied Electronics model AAE, $29.95, page 41, June 1972
- Ames Electronics model 170, $14.95, page 54, February 1971
- RCA model WC-528A Quicktracer, $14.75, page 30, July 1972

New test equipment, using an updated circuit for dynamically testing solid-state junctions, now gives the technician an alternate method to use when he doesn't want to take the extra time required for curve tracer or beta tests. Either simple or complex tests can be best, depending on circumstances. Choose the one that's right for you. Schematics of all brands of junction testers are similar, so only the RCA unit is described.

Transistor junctions can be tested with an ohmmeter, a beta tester or a curve tracer. There is another technique that for years did not receive much attention from the test equipment manufacturers. It's an old idea that was covered in the November, 1970 issue of Electronic Servicing (starting on page 26). Now several manufacturers offer their versions, and they are listed in Table 1.

How It Operates

The schematic of a simplified junction-tester is shown in Figure 1. Analyzing the circuit is a good way of describing the technique.

In most of the "build-it-yourself" articles, the output voltage of the transformer was listed as 6.3 volts, probably because heater transformers of that voltage are readily available. The value of R1 has been specified at many values between about 300 ohms and 10K ohms, for reasons to be explained a little later. For the moment, assume R1 to be 1,000 ohms, a standard resistance.

With the test leads disconnected, practically no current passes through R1, since it and the horizontal-amplifier input impedance of the scope are in series. Practically all of the transformer output voltage is applied to the horizontal input of the scope, so **there is a single horizontal line produced by deflection and essentially no vertical deflection.**

Next, assume that the test leads are shorted together. Effectively this grounds the horizontal input of the scope, and the entire output voltage of the transformer is applied to the vertical input of the scope. **The result is a single vertical line without horizontal deflection.** These characteristics of the circuit make it a convenient continuity tester which is faster to use than a multimeter.

Checking resistances and capacitances

To pursue this a bit further, consider the effect of connecting a resistance between the test probes. If it has the same value as R1, a diagonal line will be produced, because there will be equal voltage drops across the unknown resistance and R1. As the unknown resistance is decreased, the line will approach vertical; if it is increased, the line will become more nearly horizontal. Useful approximations of resistances from about .1 to 10 times the value of R1 are possible.

Now, suppose that a capacitor is connected to the test leads. If its impedance at 60 Hz is equal to the impedance of R1, roughly 2.7 mfd if R1 is 1000 ohms, the amounts of horizontal and vertical deflection will be equal once more. But, the voltage across the capacitor will be 90° out of phase with the voltage across R1, and the result is a circle. Increase or decrease the capacitance, and an ellipse results. If it is decreased, the "football" lies down; increase the capacitance and the "football" tends to stand on its end. Capacitance values from about .22 mfd to 20 mfd can be estimated fairly accurately.

As a matter of interest, inductances can be "measured" according to the same principles. Unfortunately, it requires approximately 2.7

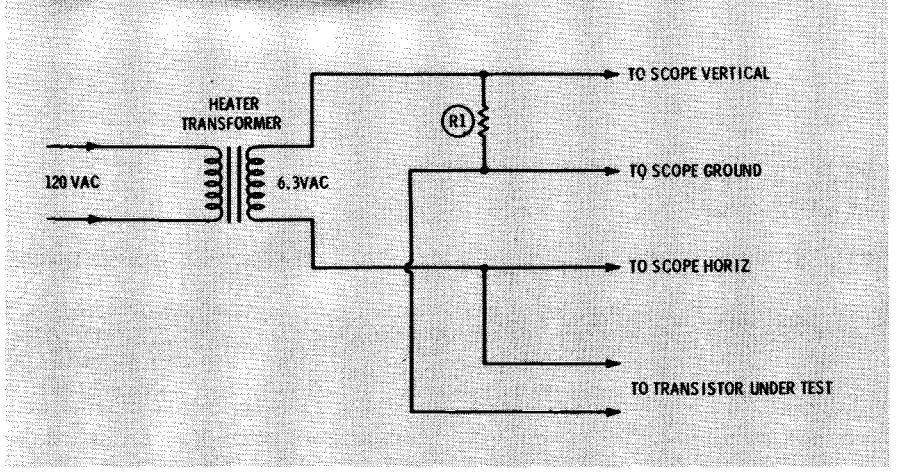


Fig. 1 Schematic of the simplified test circuit.

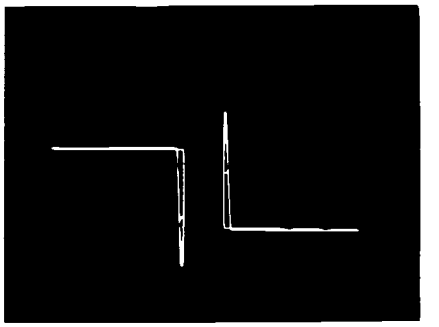


Fig. 2 Left waveform of diode is correct for grounded cathode. Right waveform shows grounded anode.

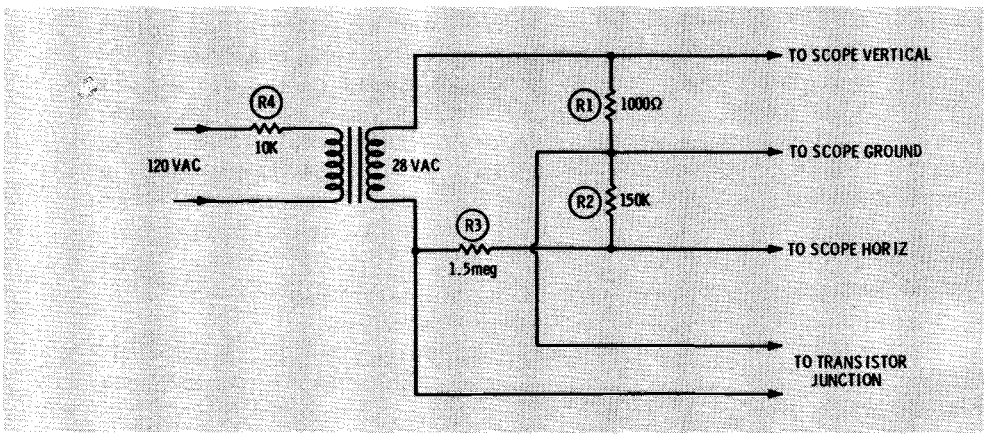


Fig. 3 Schematic of the RCA "Quicktracer" transistor and diode tester.

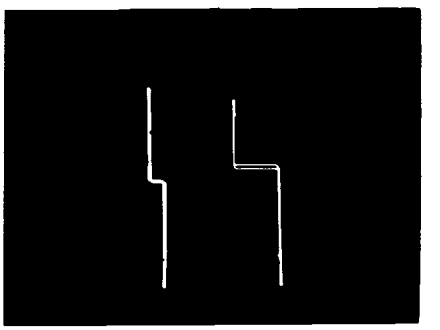


Fig. 4 Waveform of low-voltage zener at left; waveform of high-voltage zener at the right. The difference is shown by length of the horizontal part of the waveform.

henries to make a circle, and this is considerably more inductance than we usually encounter in most circuits. Continuity of inductors can be checked, of course.

Checking diode action

Until now, the impedances connected to the test probes were the same, regardless of the direction of current flow. A diode, however, is practically an open circuit during half of a voltage cycle of the transformer secondary, and a virtual short during the other half. Consequently, the scope will display horizontal sweep half of the time and vertical sweep the other half of the time. **The normal waveform is a right angle.**

If the cathode of the diode is connected to the grounded test probe, the CRT trace will be driven downwards when the diode conducts. When the diode is not conducting, the trace will be driven to the left. Reversing the diode reverses the waveform, as shown in Figure 2.

So far as this type of tester is concerned, a transistor is simply two diodes connected "back-to-back." The base is common to both diodes and is analogous to a cathode in a PNP transistor. If the transistor is NPN, the base serves as a common anode. **To test the transistor, simply test each of the "diodes" independently.**

The RCA "Quicktracer"

One of the models of this type of transistor tester currently available on the market is the RCA WC528A. Because the breadboarded job we used for years was suffering from the effects of being stepped on, we obtained one of the RCA's. The circuit used in this tester is somewhat different from the one we had been using, as you can see by comparing Figures 1 and 3.

The first difference we noted was that the output voltage of the transformer had been "upped" to about 28 volts RMS, or 80 volts, peak-to-peak. This made it necessary to add R2 and R3 to the circuit since 80 volts overdrives the horizontal input of most scopes. If the tester is to be used with a scope having very-low horizontal gain, R3 can be shunted externally to increase the drive.

With this much voltage connected to the transistor being tested, it was necessary to limit the input current to the transistor; otherwise — zap! R4 in the primary circuit of the transformer eliminated the problem. As soon as the diode, which is connected to the test probes, begins to conduct, the output voltage is drastically reduced and the current is further limited by R1, which always is in series with the diode.

According to the RCA instruction booklet, the maximum power which can be dissipated in a junction is less than 75 milliwatts. We calculated something less than this. At any rate, we tried testing some diffused-junction transistors and none were damaged.

There is a warning on the tester which says not to attempt testing MOSFET's. The gates of MOS-

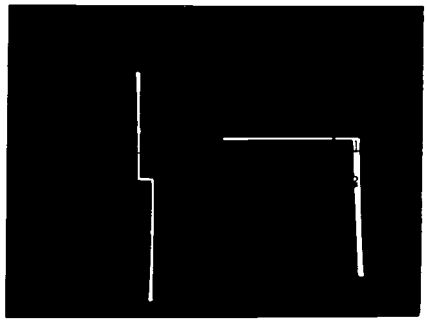
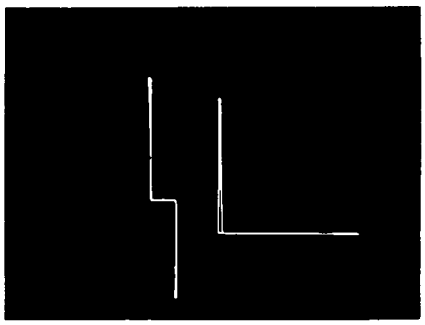


Fig. 5 Typical waveforms of normal silicon transistors. Base/emitter junctions show zener effects.
(A) PNP base/emitter at left, base/collector at right.



(B) NPN base/emitter at left, base/collector at right.

FET's just aren't made to withstand anywhere near the voltage which the tester puts out, regardless of the current limiting!

There are two reasons for using a higher voltage for testing. A few transistors may not go into base-collector conduction below about 30 volts. If one of these is encountered, a tester using a 6.3-volt transformer would indicate an open junction. The second reason is best understood by testing a zener diode.

Testing zener diodes

Figure 4 shows the typical zener waveform. The long vertical line at the right side of the waveform is the result of normal diode conduction, as discussed before. The horizontal portion of the waveform results when the diode is cut off. But, when the reverse bias becomes equal to the zener voltage of the diode, conduction occurs a second time in the voltage cycle. This produces the shorter vertical deflection at the left side of the waveform.

If a low-voltage zener, say 5 or 6 volts, is tested, the horizontal part of the waveform is short and the "zener leg" is fairly long; but not as long as the "diode leg." A 30-volt zener has a much longer horizontal section in the waveform and a correspondingly shorter "zener leg." Zeners rated above about 40 volts test like an ordinary diode, since the zener point is never reached by the tester.

By calibrating the horizontal amplifier of the scope, zeners can be measured accurately for voltage rating. A simpler method is to reverse the horizontal and vertical scope leads. Don't forget to subtract about .5 volt from whatever is measured, to compensate for the fact that a diode cuts off when it still has about one-half a volt of forward bias.

Zener effects in transistors

The emitter-base junctions of nearly all silicon transistors used in home-entertainment electronic products exhibit zener characteristic with less than 40 applied volts. Therefore, the RCA tester produces a zener waveform when connected to the emitter-base junction, and a diode waveform when connected to the collector-base junction. Figure 5 shows some typical waveforms.

It also is possible to determine whether a transistor is a PNP type or an NPN by observing the waveform (Figure 5). As stated before, the base of a PNP device serves as a cathode, but the base of an NPN transistor appears as an anode. If the grounded test lead is always connected to the base of the transistor, it then becomes easy to identify the type. Considering only the base-collector waveform, "Up at the left is NPN; down at the right is PNP."

At this point we are all set to go out and identify transistor types and determine which wire goes to which element. Well, almost.

Figure 6 shows what happens when the tester is inadvertently connected to the collector and the emitter. If it were not for the zener characteristic of the base-emitter junction, the transistor would appear as an open circuit. But this zener action allows conduction when the base-collector junction is forward biased and the base-emitter junction is in zener conduction. The waveform is almost the same as the typical base-collector waveform.

To positively identify the transistor leads, make random connections until the typical zener waveform is observed. The transistor lead which is not connected at this time has to be the collector. Next, connect the hot lead of the tester to the collector and touch the grounded lead to each of the other two transistor leads, and note the length of the horizontal section of the waveform. It will be shorter when the tester is connected to the base of the transistor.

There are a few transistors whose base-emitter junction does not act as a zener below 40 volts. In this case, the base-emitter waveform looks like the base-collector waveform, and there will be little conduction when the "Quicktracer" is connected to the emitter and the collector. Make random connections to the transistor until you find a pair of leads which produce a horizontal-line waveform. The remaining terminal is the base. Connect the grounded test lead to the base to determine if the transistor is NPN or PNP; but don't try to figure out which is the collector and which is the emitter—it can't be done with this instrument.

Out-Of-Circuit Transistor Testing

There are five common modes of transistor failure: open junction, shorted junction, excessive leakage, reduced alpha or beta, and noise. Noise is best discovered by signal tracing with the instrument turned on, so it is hardly necessary for a tester to detect noise. Testing for alpha or beta is valid, but there are some practical factors which must be considered.

First, the desired alpha or beta of the transistors in any home-entertainment instrument is seldom published by the manufacturer. Second, when it is published, it is a nominal value which may vary 50%

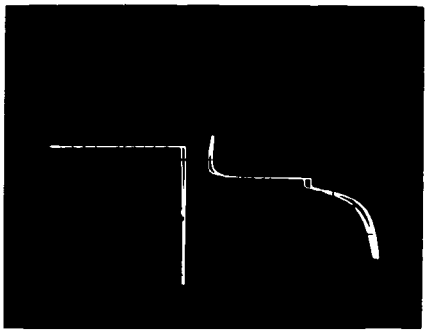


Fig. 6 Typical emitter/collector waveforms. Waveform at left produced when the base/emitter zeners; base/emitter that does not zener gives the waveform at the right.

in each direction. Third, the accuracy of many service-shop-quality testers is less than impressive.

Leakage in transistors is certainly an important factor, and it appears that a test for this kind of failure should be built into any transistor tester. Actually this may be less important than it seems. For one thing, a transistor which has slightly too much leakage begins to overheat. This increases the leakage, which increases the heat, which increases the leakage, etc. In many circuits this leads to an eventual short circuit; in some circuits, a point is reached where additional leakage would cause a decrease in dissipation, and complete destruction does not follow. But even in this case, the leakage resistance probably will remain low enough to be detected in an out-of-circuit test.

In the RCA tester, the value selected for R1 (Figure 3) is 1000 ohms. A leakage resistance in a transistor of 5000 ohms or less will cause the horizontal section of the waveform to begin to tilt towards vertical. While 5,000 ohms of leakage resistance is excessive in most transistors, the leakage resistance seldom stays above this value once the transistor has suffered a thermal runaway.

Greater sensitivity to leakage could have been obtained by increasing the value of R1. However, if the instrument is to be used for in-circuit testing, as well as out-of-circuit testing, a high value for R1 makes the tester overly sensitive to the effects of the shunt circuits which are almost always present. One-thousand ohms for R1 is a reasonable compromise.

In practice, the great majority of failures are either open junctions or shorted junctions, and these are readily detected by the tester described here. **A short produces a vertical line; an open produces a horizontal line; a good transistor produces right angles.** Needless to say, if either junction is abnormal, the transistor is defective.

In-Circuit Testing

If a transistor is connected in a circuit which has high impedances shunted across the junctions, as illustrated in Figure 7, the in-circuit waveforms will be the same as those observed if the transistor is tested out of the circuit. It follows that, any time a transistor produces right-angle patterns, it is good.

Most circuits have impedances shunting the transistor which are low enough to modify the waveform. Figure 8 shows the effects

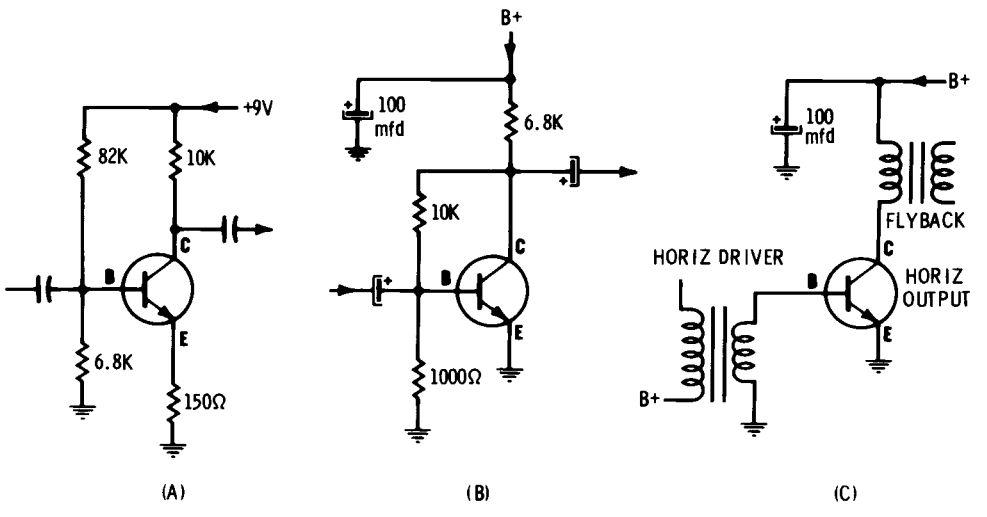


Fig. 7 Effects of the circuit on the waveforms depend on the impedance of the circuit. **(A)** High-impedance circuits don't change the waveforms. **(B)** Medium-impedance circuits give the effect of a leaky transistor. **(C)** Low-impedance circuits produce the waveforms of a shorted transistor.

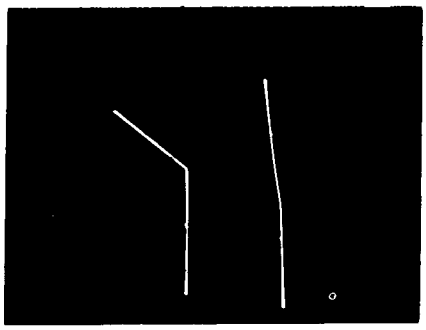
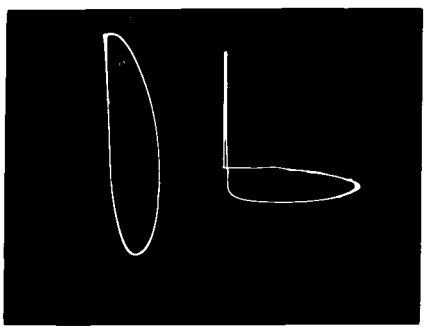


Fig. 8 Effects of resistance or capacitance across a good junction. **(A)** Lower-value resistance (270 ohms at right) makes the line nearly vertical, while a higher-value resistance (3300 ohms at left) changes the angle very little.



(B) Capacitance of .1 mfd makes horizontal ellipse (left), while 2 mfd produces a vertical ellipse (right).

of resistances and capacitances shunted across a junction. A little experience will make it possible to predict with fair accuracy what the waveforms should be in any given circuit.

There are instances where the shunting will make the test completely unreliable. For example, a common-emitter amplifier driven by a transformer may have only a few ohms of shunt resistance across the base-emitter junction. Many horizontal-output transistors fall in this category. The solution in a case like this is to disconnect the transistor and test it out of the circuit.

The value of R1 in the tester (Figure 3) can be reduced by shunting it, but this doesn't really accomplish very much. True, the external circuit will have less effect on the waveform; but actual transistor leakage will also be harder to detect.

In the literature packed with the tester, RCA included several pages of in-circuit waveforms for transistors in their color television receivers. They have stated in the booklet that additional waveforms will be published in the future. By comparing the waveforms obtained while troubleshooting with those which have been published, just about all of the guesswork is taken out of testing.

For other makes of equipment, and for those instruments which RCA has not covered, the following technique works well.

First we determine the general area of the trouble, as indicated by the symptoms. Next, we test all the transistors in that area and assume that any which produce right-angle waveforms are good. The transistor which is at fault probably will be dead, shorted or open, so we are primarily looking for these faults.

If the bad transistor isn't located by the "first pass," drag out the schematic and see if the unusual waveforms produced by some of the transistors can be produced by the circuits in which they are connected. It usually doesn't take very long to find one where this cannot be done, and that solves the problem.

For future reference, simply draw the waveforms produced by each good transistor alongside it on the schematic. This only takes a minute or so, and it will save a lot of head scratching in the future. These waveforms may not be as attractive as the ones which have been published, but they aren't likely to become misplaced, either.

There is one more thing to consider whenever transistors are tested in-circuit. It is always possible that some other component in the circuit is actually defective, and is the cause of a fault indication. A shorted coupling capacitor, for example, often will appear to the tester as a leaky emitter-base junction. Another possibility is a perfect right-angle waveform where the junction is known to be shunted by a low resistance; in this case the resistance must be open. This doesn't make the testing procedure invalid, because the trouble will have to be found sooner or later. In fact the tester might make it a lot sooner.

Conclusion

The method of transistor testing described here is not completely accurate for in-circuit work; but neither is any other technique that we know about. It is much faster than some methods, and any sacrifice of accuracy is compensated by this convenience. All the transistors in a suspected circuit area can be tested in a few minutes. This means that, if the culprit isn't found, only these few minutes are lost. When it is located, these few minutes will be gained many times over.

Out-of-circuit, this testing technique is adequate for troubleshooting. Shorts, opens, and high leakage are easily spotted. From a practical standpoint, this often is all that is necessary. Measuring several other transistor parameters may be interesting, but it seldom helps much in troubleshooting. The correct values usually aren't known anyway.

The technique permits rapid "go/no-go" testing with little danger of damaging transistors. □

MUST BE A SHORT IN IT SOMEWHERE!

Which color TV needs fewest repairs?

Here are the questions and answers from a nationwide survey.

QUESTION: "In general, of the brands you are familiar with, which one would you say requires the fewest repairs?"

ANSWERS:

Zenith	**35%**
Brand A	14%
Brand B	11%
Brand C	5%
Brand D	3%
Brand E	3%
Brand F	2%
Brand G	2%
Brand H	2%
Brand I	1%
Other Brands	2%
About Equal	13%
Don't Know	11%

QUESTION: "In general, of the brands you are familiar with, which one would you say is easiest to repair?"

ANSWERS:

Zenith	**37%**
Brand A	24%
Brand B	13%
Brand C	5%
Brand D	4%
Brand E	3%
Brand F	3%
Brand H	2%
Brand G	1%
Other Brands	2%
About Equal	11%
Don't Know	4%

HOW THE SURVEY WAS MADE.

For the second consecutive year, one of the best known research firms in America conducted a study of independent TV service technicians' attitudes toward brands of color television.

And again Zenith was the number one brand named in answer to each question, as shown in the charts.

Telephone interviews were conducted with TV service technicians themselves in April, 1972, and again in April, 1973, in more than 170 cities from coast to coast.

To eliminate the factor of loyalty to a single brand, the study included only shops which serviced more than one brand of TV.

Survey details are available on request. Write to:
Zenith Radio Corporation, 1900 N. Austin Ave., Chicago, Ill. 60639

Again this year, TV service technicians say Zenith.

QUESTION: "In general, which of the brands you are familiar with is the highest quality color TV?"

ANSWERS:	
Zenith	**45%**
Brand A	24%
Brand B	10%
Brand C	6%
Brand G	5%
Brand E	4%
Brand F	3%
Brand D	2%
Brand H	2%
Brand I	1%
Other Brands	3%
About Equal	8%
Don't Know	4%

QUESTION: "If you were buying a new color TV set for yourself today, which brand would you buy?"

ANSWERS:	
Zenith	**35%**
Brand A	23%
Brand B	12%
Brand C	6%
Brand D	4%
Brand E	4%
Brand F	3%
Brand G	3%
Brand H	2%
Brand I	2%
Other Brands	5%
Don't Know	8%

NOTE: Answers total more than 100% because some service technicians named more than one brand.

ZENITH®

The quality goes in before the name goes on

For More Details Circle (11) on Reply Card

How to start your own auto-sound business

By Carl H. Babcoke, CET, and Joseph J. Carr, CET

Many electronic shops now refuse to repair car radios or car-tape players. And yet those who specialize in this service are extremely enthusiastic about it. Where it has been pushed, the auto-sound business volume has grown tremendously. You might be overlooking a good bet if you continue to ignore this "stepchild" of our industry.

What does the future hold for auto-sound businesses? Is this field in the infancy of a huge and prosperous growth, or is it a flash in the pan? Let's examine the prospects.

About 90% of all new cars leaving the auto dealer are equipped with some kind of radio or tape unit, even if it is only an AM radio. Also, 4% of 7-million cars in 1971 and 5% of 8-million cars sold in 1972 had factory-installed stereo-tape units. These facts are sufficient proof of the large Original Equipment Manufacturer (OEM) market for repairs.

Another source says a total of 21% of all cars on the road have some type of tape player. And this is not considered the saturation point; there's room for many more sales. In addition, many units are low-cost "bolt-on" machines sold during the first part of the auto-sound boom. Their owners should be good prospects for better machines, such as in-dash or 4-channel units. All these indications show a large potential for growth in both sales and service of auto-sound equipment.

If you need further proof of the desirability of getting into the auto-sound business, just consider the many specialized auto-sound stores and shops that have opened in the larger cities. The field is wide open and still growing.

Auto electronics

Another related field that is expected to increase in the predictable future is auto electronics. This includes such things as radar speedometers, automatic skid prevention, automatic braking, theft prevention systems, safety units, electronic ignition and computer operation of the engine for emission control and efficiency.

It's possible these machines will increase the complexity of cars beyond the ability of the average garage to cope with them. In that case, the auto-sound shops would be the natural ones to inherit these activities.

Should Auto-Sound Be Separate?

Should you integrate auto-sound into radio-TV servicing, or is it best to keep it separate? A firm yes or no is not possible, because the answer depends partially on your area and whether or not the potential auto-sound business is sufficiently large to support a separate location. But, it is generally agreed among the experts that physical separation of the two businesses is desirable. For one reason, the best location for auto-sound is not necessarily the best for a TV shop, and vice versa.

If you have no choice and must operate both businesses under one roof, at least move the TV and auto-sound displays to opposite sides of the sales floor. And use a separate bench having its own specialized tools, parts and test

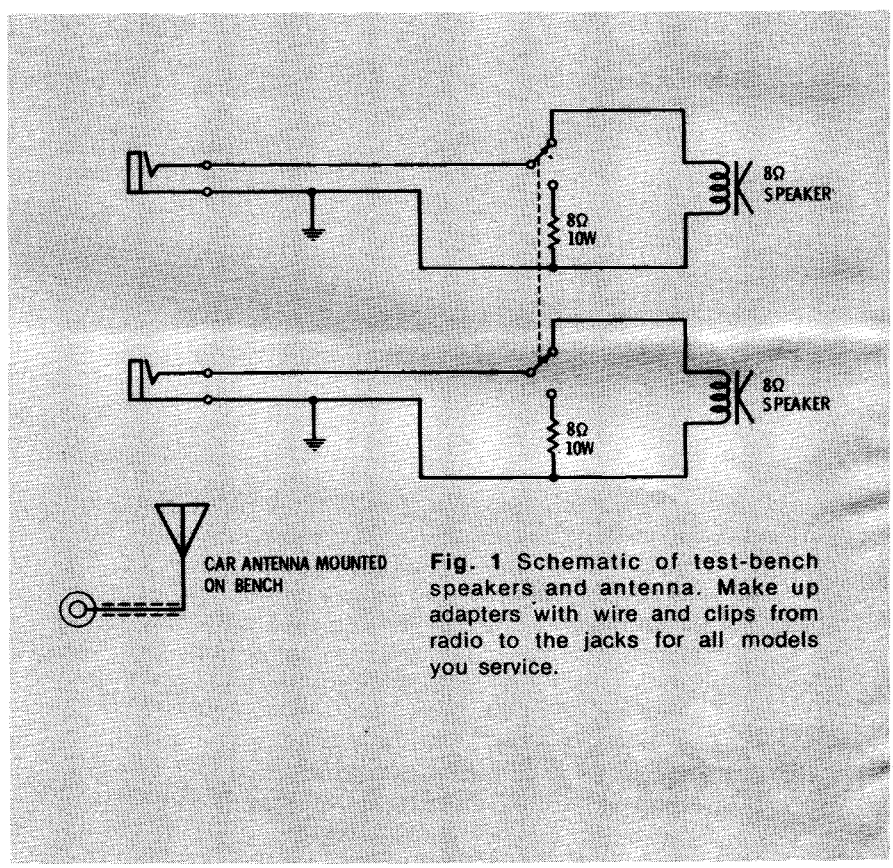


Fig. 1 Schematic of test-bench speakers and antenna. Make up adapters with wire and clips from radio to the jacks for all models you service.

equipment for auto-sound repairs. Preferably, have your employees work on one or the other, but not both.

Sales, Service or Both

In the industry, there is no unanimous opinion about whether it's better to sell only, service only, or to do both. You must answer this for yourself.

However, there are strong arguments in favor of selling machines, accessories and tapes, installing machines, and servicing during the warranty the machines you sell. This is the minimum. Some authorities are strongly in favor of also servicing all brands and models on the theory that these customers will be back to buy other equip-

Table 1

TEST EQUIPMENT RECOMMENDED FOR AUTO-SOUND

VTVM (preferably one with low-voltage ohmmeter and low-voltage DC scales for transistor work)

Oscilloscope (specifications not critical)

AM Signal Generator (should cover from 262 KHz to 10.7 MHz, or more)

Power Supply or Battery Eliminator (minimum ratings: 6 volts at 20 amps, and 12 volts at 10 amps)

VOM (small, rugged VOM for use in cars)

Test Speakers (8-ohm 4-inch in cardboard carton is okay for use in cars. Space two on the work bench for stereo use)

Test Antenna (mount an "Eight Ball" type on the bench, and keep an extra one handy for use in cars.)

Multiplex Generator

Signal Tracer

USEFUL, BUT NOT ESSENTIAL

Transistor car-radio Analyst — Audio Generator
Good-quality FM Generator — Transistor Tester
Digital Frequency Meter

Table 2

MOST-USED TRANSISTORS AND DIODES

Use	Type Code	Case Style	Sylvania (ECG)	GE	Motorola (HEP)	RCA	Delco
AM: RF, IF	PG	.....	100	1	631	SK3005	DS-25
and conv	NS	.....	123A	17	736	SK3020	DS-72
FM: RF, osc	PG	.....	126	9	251	SK3006	DS-41
and mixer	NS	.....	108	11	56	SK3039	DS-74, DS-81
FM: IF	PG	.....	126	9	251	SK3006	DS-56
	NS	.....	123A	17	736	SK3020	DS-71, DS-72
Audio preamp	PG	.....	102A	2	632	SK3004	DS-26
and driver	NS	.....	123A	17	736	SK3020	DS-71
Audio output	PG	TO-3	121	.....	.....	.....	DS-503,DS-520
	PG	TO-36	105	4	231	SK3012	DS-501,DS-525
	NG	TO-66	155	.....	.....	.....	.....
	NS	plastic	152	.....	.....	.....	.....
	PG	TO-66	131	30	642	SK3052	.....
	NS	TO-66	175	.....	.....	.....	.....
	NS	TO-3	130	19	247	SK3027	.....
Motor regulator	NS	TO-3	130	19	247	SK3027	DS-509
	NS	P-66	152	.....	.....	SK3041	.....
	PS	P-66	185	.....	.....	.....	.....
AFC diode	S	.....	.....	.....	.....	.....	DS-55
Zener diode	S	.....	138	.....	.....	.....	DS-49
Det and AGC diodes	G	.....	109	1N34AS	134	1N34A	DS-27

Type Codes: P = PNP, N = NPN, G = Germanium, S = Silicon.

ment. A satisfied customer usually gives you free the best advertising you can have.

OEM Warranty Repairs?

Should you attempt to become a warranty station for one or more of the manufacturers? Many auto-sound store managers believe an efficient operation can show a small profit on warranty service. And such repairs help to fill in the down-time, especially when the business is just starting. The bonus is the many warranty customers who already know and trust you. The answer, then, is a moderate "Yes".

In your first letter to the manufacturer, include financial information, a list of major test equipment, perhaps a picture of your facility and a letter of recommendation from a local garage.

Drive-In Space

Space for bringing inside one or more cars during installations or repairs is a necessity. This is true, even in those parts of the country blessed with a mild climate.

Don't carry tools back and forth from drive-in to the bench. If you do you'll find the tools are often at the other location when you need them. Mount the tools on peg boards on the walls, or keep them in a portable tool hamper. Provide good lighting, an extension cable with light and AC outlet, and plenty of power outlets around the walls. Plan for efficiency.

Finding A Good Location

A good location must be where many people shop or travel, so they can read your signs and know where you can be found.

Just as important, the location should be near several garages. Nearness expedites movements of cars or machines between the businesses, thereby saving time, money and aggravation.

Shopping-center locations near garages are a good bet; the only problem is in obtaining drive-in facilities.

Another possibility is to obtain and remodel an abandoned gasoline filling station. Facilities for drive-in are there already, and often the space near the lifts is sufficient for installation of a repair bench. One of the minor advantages is that the auto-sound units are not very large, requiring only small benches and storage shelves. The office area, although often tiny, should be large enough for a beginning business, or as the branch office of your chain.

A Time To Calculate

After you have considered all of the preceding suggestions, and found a location that is suitable, you now should take pencil and paper to figure the cost of operation, how much cash, materials, tools and test equipment you have, how much additional cash and materials you will need, and where you might obtain loans or credit.

One rule of thumb is that you need enough cash when starting a new business to permit operation for six months, even if you had **no** income during that time. Of course, if you have firm commitments for a substantial amount of work, you might be able to reduce this somewhat.

But be extremely careful that you do not run out of Working Cash at any time. There is nothing more discouraging than to find at about the fourth month of operation that you don't have enough cash for the payroll or to pay your own salary. (See "Cash Management" in the October issue of Electronic Servicing.)

Next, if all this still seems possible and practical, pick out a method of bookkeeping adequate for the volume of business you expect. Don't wait until you actually start operations, because the crush of many details might make you forget about bookkeeping. It's much too important to be overlooked.

Setting Up A Repair Bench

The layout and equipment of a test bench can nearly make-or-break the servicing end of a business because of the degree of efficiency. Lighting over the bench should be bright and shadowless, and the tools and test instruments should be in handy locations.

Permanently mount a car-radio antenna with the normal lead wire, and two heavy-duty speakers to the bench. The speaker wiring should be arranged as shown in Figure 1, and adapter cables made up for all the models you work on. Three feet of lampcord with a phone plug on one end and a pair of alligator clips on the other is probably the adapter most often needed.

Use only a heavy-duty type of power supply. Signal-seeker models draw a heavy current during the recock cycle. If the voltage drops then, the mechanism might hang up and burn the recock solenoid.

Of course, you can use an automotive storage battery with a charger to maintain the charge. Don't mount such a battery on concrete. Obtain a well-vented marine battery box. Use care not to overcharge the battery, for this causes sulphuric acid and hydrogen gas to be formed. Turn off all loads before disconnecting the battery cables. A spark from a cable might explode the hydrogen with a bang that can both deafen you and spray your face with acid. Perhaps you can see why we recommend an AC-powered supply.

Table 1 shows the electronic test equipment recommended for auto-sound use. In addition, several mechanical tools are necessary, such as:

- a slow-speed electric drill of the safety type (ground wire or doubly insulated);
- a one-inch hole saw (buy the best you can find);
- several rat-tailed files;
- a straightened-out coat hanger (for fishing wires); and
- an assortment of good-quality wrenches and hand tools.

Training Of Employees

The training, knowledge and experience necessary for a technician to work efficiently on auto-sound equipment is nearly identical to that required for home-entertainment products. A superhet is a superhet regardless of whether it is in a car or in a console cabinet. Service data for American-made products is readily available from the manufacturers or from Photofact.

Only the knowledge necessary for R&R of the machines in the cars is specialized. Some of the procedures are a little exotic, such as the one for an Oldsmobile Toronado which requires dropping the steering column. But Delco publishes brief R&R instructions in their manuals, and the garages probably would let

you look at their books.

Knowledge comes fast here, because there are only so many brands of OEM radios and tape players.

Typical Repairs

Probably one-half of all service problems will be the customer's fault. Perhaps he notices the normal intermittent distortion on FM caused by multi-path reception, and complains. Or he buys a cheap bootleg tape which promptly jams, or he notices the poor sound quality. A do-it-yourself type might attempt to add more speakers and cause a short that blows both output transistors.

Often speakers are mounted facing up to the windshield, a position certain to bring dust and condensed moisture to the cone. Not to mention spilled cokes or malted milks! The mortality rate is very high.

Volkswagens are nearly air tight, and when a door is slammed and all the windows are closed, the speaker cone might be bottomed by the pressure wave. Or, opening a door might pull the cone nearly out of the basket.

Defective transistors, particularly output types, and bad tape motors account for most of the electronic repairs. Table 2 shows many of the universal replacement transistors and diodes you will need.

Cleaning and lubrication of the tape-player mechanisms must be done on a fairly regular basis. Cleaning and demagnetizing the head should be done even more often to avoid distortion and noise.

Volume and tone controls become defective quite often, and obtaining them can be a problem. There are so many different kinds. If you service only one brand of machine, perhaps it's best to stock the most popular OEM controls. But, if you service all brands, the universal types are more practical.

Table 3 lists the names and addresses of the OEM manufacturers. Few, if any, will sell parts direct to you, but you should contact them for the name and address of the distributor nearest you who stocks their products.

Antennas

One sideline that can be profit-

Table 3

ORIGINAL EQUIPMENT MANUFACTURERS

Manufacturer:	Used In:
Delco Electronics Car Radio Division 700 East Firmin Avenue Kokomo, Indiana 46901	All General Motors cars, General Motors trucks, GM of Canada and Chrysler
Double Diamond Electronics Limited (Philips) Autronics Division 34 Progress Avenue Scarborough, Ontario, Canada	Chrysler products
Bendix Corporation Automotive Electronics Div. P.O. Box 2302 Newport News, Virginia 23602	Imports for Ford, Chrysler
Philco-Ford Corporation Lansdale Division Church Road Lansdale, Pennsylvania 19405	Ford
Motorola Inc., Automotive Products Div. 9401 West Grand Avenue Franklin Park, Illinois 60131 Attention: Ron Groene, National Sales Mgr.	Ford, Chrysler, American Motors, VW, Porsche, Audi, etc.
Motorola Inc., Automotive Products Div. 2553 North Edgington Street Franklin Park, Illinois 60131 Attention: Steve McShane, Nat. Service Mgr.	Ford, Chrysler, American Motors, VW, Porsche, Audi, etc.

Table 4

ELECTRONIC SERVICING ARTICLES ON AUTO SOUND

Jan 71, pg 32	IC's In Auto Radio
Mar 71, pg 50	Finding And Eliminating Auto-Radio Noise
Apr 71, pg 42	1971 Radio Designs
May 71, pg 20	RF Amplifier And AGC Troubles In Car Radios
Jun 71, pg 30	Troubleshooting Motors In Auto-Tape Players
Jul 71, pg 42	Stereo FM Auto-Radio Servicing
Aug 71, pg 52	Eight Prime Troubles In Auto Radios
Nov 71, pg 44	Auto-Cassette Players
Dec 71, pg 50	Philco-Ford's New Varactor-Tuned Stereo Radio
Jan 72, pg 52	Bendix 1972 Stereo-FM Auto Radio
Mar 72, pg 50	New In Auto-Radio Audio
Mar 72, pg 56	The Staar System—Cassettes For Autos
Apr 72, pg 22	Servicing German-Made Auto Radios
May 72, pg 44	Stereo-Indicator Circuits
Jun 72, pg 54	Antenna And RF Troubles
Jul 72, pg 54	Understanding Signal-Seeker Car Radios
Aug 72, pg 40	Typical Defects In Auto-Tape Players
Oct 72, pg 34	The Most Common Car-Radio Defects
Nov 72, pg 18	Servicing Automotive Test Equipment
Jan 73, pg 32	A First Look At The Delco-Radio Tape Combo
Feb 73, pg 39	A New Look At Transistor Substitution For Auto Radios
Aug 73, pg 38	Understanding Solid-State Ignition Systems

able is the sale of new or replacement antennas. It's wise to stock a few basic types, such as swivel mounts, single-stanchion side-cowl, and the standard universal (often called 8-ball because of the shape). Key-lock disappearing antennas are very useful in areas where vandalism is a problem.

Determining Prices

Probably you would like for us to give you a list of prices to be charged for auto-sound installations or repairs. Unfortunately, we can't do this. Federal law forbids it, for one reason. More importantly, the right prices for one shop would be wrong for another.

After the first six months, you can tell from your records and financial statements whether your prices are low or high. But, for the first few months, use a price list composed of educated guesses plus approximations from the prices charged by your competitors.

Remember that volume is required to make money. If a bench man for TV's is considered doing satisfactory work by repairing six sets a day, an auto-sound technician must do 12 to 15 units to make the same money.

Going After Business

Let's assume you are set up ready for business in a good location well identified with attractive signs. The next step is to get some customers. How do you go about this?

A listing in the Yellow Pages is highly recommended. Many operators say they obtain more business from the Yellow Pages than from all other advertising sources combined. However, it's only possible to obtain a new listing once a year. Try other ideas while you wait.

Newspaper ads can be very fruitful, if they are skillfully prepared and conditions are just right (see Electronic Servicing, June 73, page 44). Some experienced managers say one ad might draw fine, and the next do virtually nothing. Don't depend on one solitary ad to perform miracles. Advertise regularly.

Radio and television commercials can be very effective, but only if they are used often and regularly. A single commercial is usually forgotten immediately unless it is repeated soon.

But the sources of the most business obtained by the least amount of trouble and expense are the local garages and service stations.

Approaching The Garages

Most of the business with garages will be warranty repairs. Go to see the service manager of each garage at a time convenient to him. Make your sales pitch. Emphasize anything your research has shown to be a weak or sore point about the service he has used in the past. But, don't promise the impossible; he is in service, too, and understands the practical limitations. Don't attempt a "snow" job.

Remember that the best way to make new-car dealers happy is to keep irate customers off their back. You do this by having the customer's machine ready by the time promised.

Joining forces with the air-conditioner installers and vinyl-top shops in customizing new cars can be very lucrative. Rear-seat speakers and 4-channel sound are some of the goodies customers pay well for.

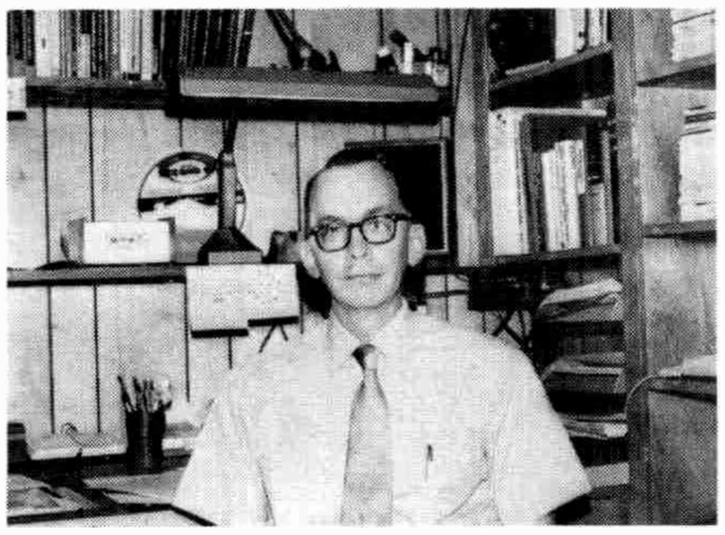
Repair work from used-car dealers can be another good source of income. Some dealers will ask for a flat-rate-per-radio plan in exchange for a guarantee of a certain minimum amount of business. But, most auto-sound shops prefer to charge on a time-and-material basis. Chances are, the dealers will want estimates, and you must then decide whether or not to make a charge for them.

Summary

The auto-sound business generally is growing rapidly, and the saturation point is not in sight. New businesses which plan wisely and operate efficiently should be able to survive and expand with the trend.

Just remember that good business practices alone are not enough unless they include an adequate bookkeeping system and good public relations (refer to Electronic Servicing for August 1972, page 14 for some suggestions about improving public relations).

Solving elusive color-TV troubles



By Robert L. Goodman, CET

All of these case histories were taken from "tough dog" color-TV repairs, and represent many hours of conferences and no-charge bench time.

Another technician brought me for analysis a Zenith color-TV receiver (16Z7C50, Photofact 1055-2) with an unusual convergence problem. As part of his tests, he had changed the convergence yoke and control-board assembly, and had even tried a new deflection yoke. The vertical and horizontal pulses fed to the convergence board were okay, he said. It was difficult to imagine any defect that could escape such an extensive series of tests and replacements. But the problem remained.

Poor Convergence

A fuzzy picture had been the original complaint of the set owner. One glance at the screen confirmed this. On the left side of the screen the convergence was very poor.

An excellent method of checking for convergence problems is to attempt to converge while carefully noting the actions of all controls. In this case, adjustment of the controls for red/green horizontal lines on the left produced virtually no movement of the lines. As shown in Figure 1, the lines were widely separated.

Usually symptoms such as these would be caused by a defective component on the convergence board, or an open coil in the assembly around the neck of the picture tube. But all these components had been changed at one time without any noticeable change of symptoms.

In fact, no suspects remained except the two sources of horizontal pulses applied to the convergence circuit. Positive-going pulses of 220 volts p-p (Figure 2), and 17 volts p-p of negative-going pulses should be found at pins #4 and #2 respectively of the convergence plug.

Amplitude of the positive-going pulses was okay, when I measured with my triggered-sweep calibrated scope, but the negative-going ones were a whopping 140 volts p-p.

This excessively-high reading pointed to a defect in the flyback transformer, and replacement of it eliminated the convergence problem. I can't explain what sort of defect could cause such high amplitude. When a transformer is bad, usually the pulses are low-amplitude or missing.

Repetitive AGC Failures

Four times during a period of several weeks, a Zenith 4B25C19 color chassis (Photofact 1166-3) had popped loudly, lost vertical and horizontal locking, and become darker (Figure 3). After each failure, it was found that Q12 (AGC keyer in Figure 4) was open from collector to emitter, or had a base/emitter short. The circuit is typical of those in which the AGC keyer transistor acts as a variable resistor in series with the so-called "pulse gate" diode to change the amount of positive rectified voltage at the junction of X13 and C94. Therefore, the transistor is supplied with video, DC bias and horizontal pulses.

It was obvious the arc was causing an overvoltage to appear at Q12's base, collector, or emitter (or all of these points). The question was, which points?

After considerable checking and time testing (necessary because of

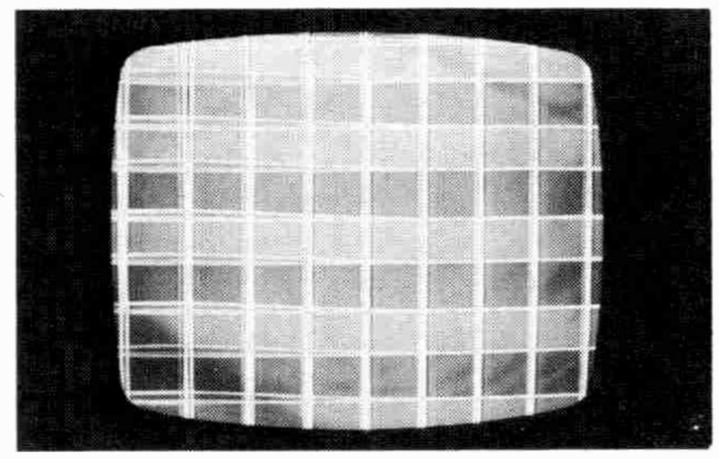


Fig. 1 Red and green horizontal lines on the left could not be converged.

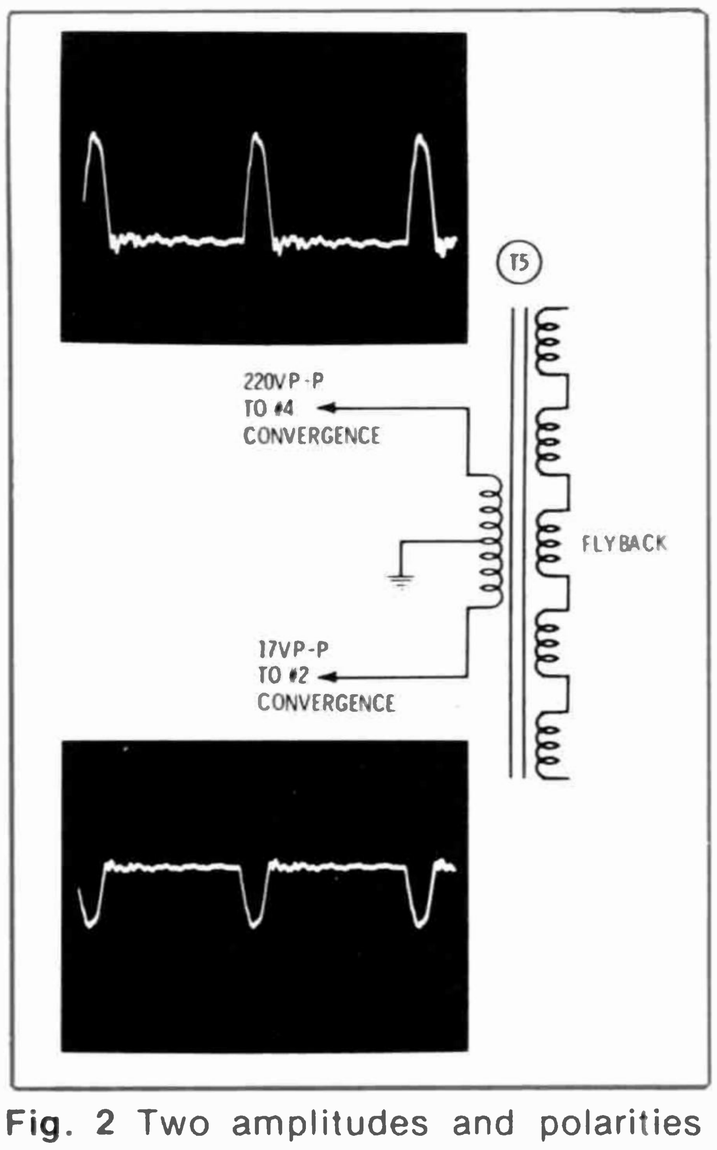


Fig. 2 Two amplitudes and polarities of horizontal pulses are taken from the flyback transformer.

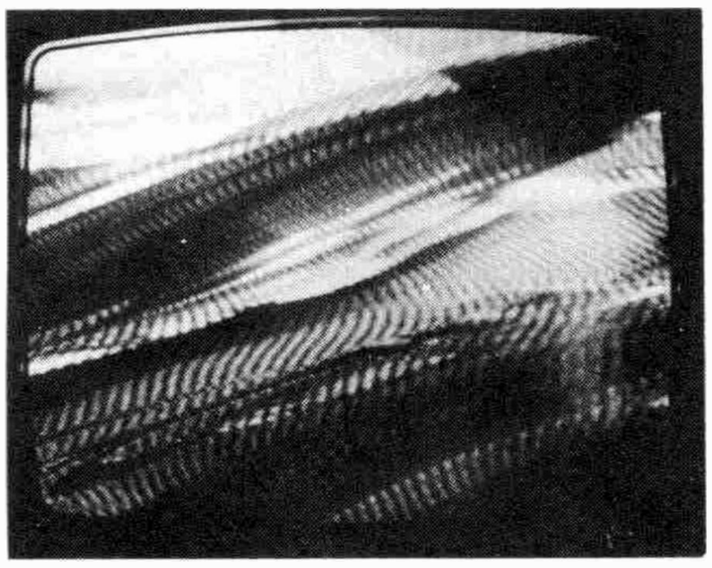


Fig. 3 A dark, out-of-lock picture resulted from failure of the AGC-keyer transistor.

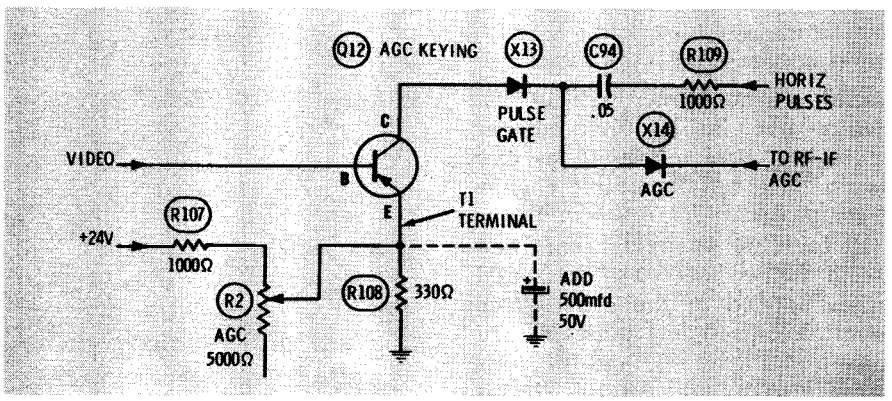


Fig. 4 Schematic of the AGC-keyer stage. Add the 500-mfd emitter bypass capacitor for extra protection against arcs.

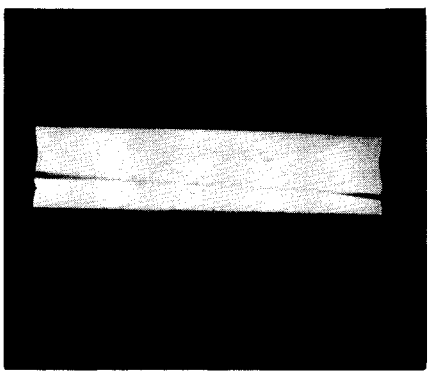


Fig. 5 This very-small picture was caused by a low 125-volt supply.

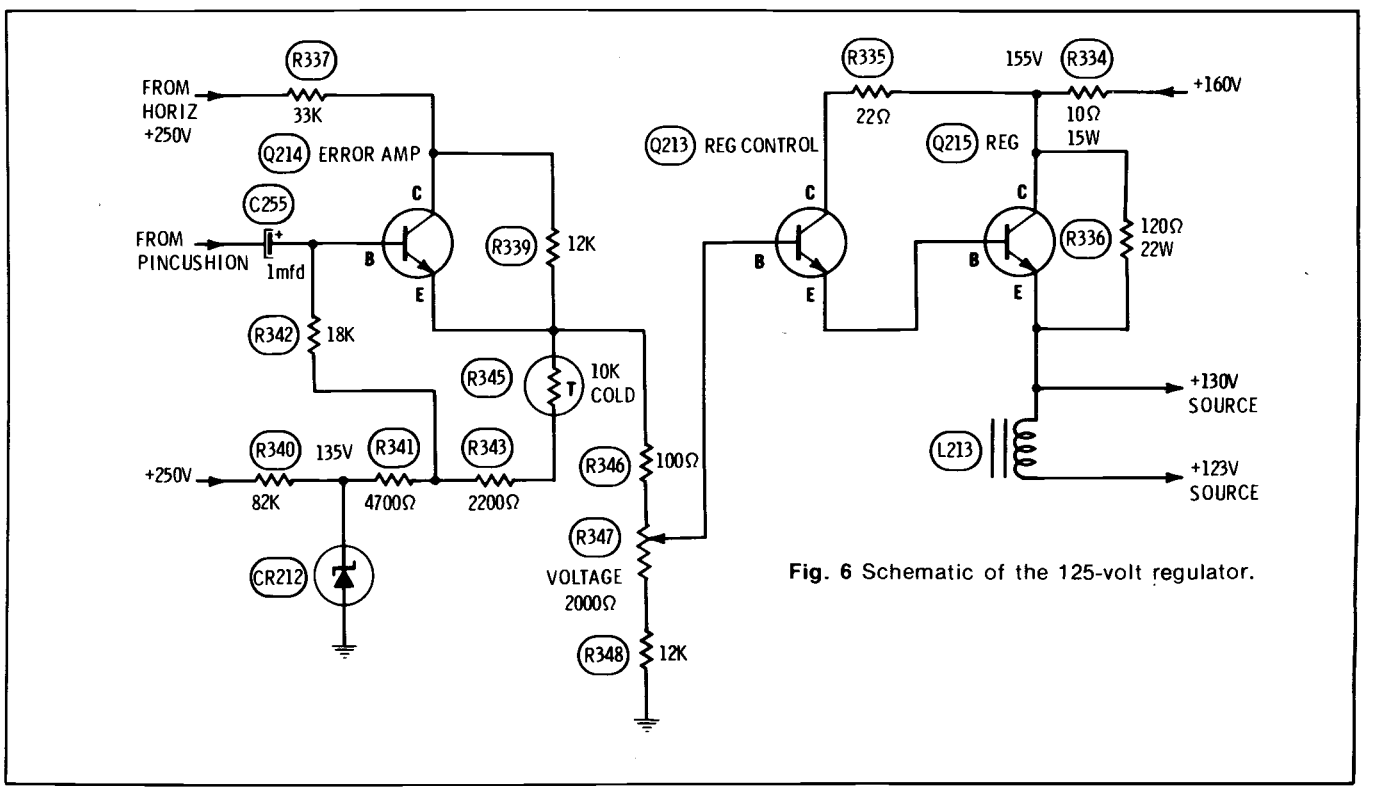


Fig. 6 Schematic of the 125-volt regulator.

the highly-intermittent nature of the arc), I discovered the loud pop was caused by an arc in the 19CG3 damper tube. The complete schematic shows that the heater of this tube is supplied by the same winding of the power transformer feeding the 24-volt supply rectifiers. Evidently, the arc generated a transient that traveled down the 24-volt line to the emitter of Q12.

In addition, I found one of the 24-volt wires had been dressed so the insulation was touching the lug of the AGC control. And, any high-voltage arc also might be expected to reach the collector via X13, C94 and R109.

I replaced the 19CG3 damper tube, redressed the 24-volt wire and then, as an extra precaution, added a 500-mfd 50-volt capacitor from emitter to ground.

There have been no more callbacks since that time.

Arcs

Arcs anywhere in the chassis can cause failures of the solid-state components. Protective sparkgaps are used extensively, but they can't be expected to eliminate all danger. Smaller, secondary arcs can be generated by capacitive action in circuits far removed from the high-voltage area. These are more than

sufficient to knock out transistors or diodes.

The best protection against arcs is to eliminate the arcs.

Small Picture

Because the picture on the Zenith 25DC57 solid-state color set (Photofact 1315-3) was shrunken on all four sides (Figure 5), I immediately suspected a defect in one of the power supplies (Figure 6).

There are two separate regulated supplies, 24 volts and 125 volts. In addition to regulating the DC voltages, the circuits also have a filtering action because of their fast responses.

The 24-volt supply was within tolerance, but the 125-volt source measured only about 75 volts.

First, I checked all the transistors (Q214, Q213 and Q215) and the zener diode, and found them okay. Also, there were no shorts or low-resistance loads on the supply. The 160 volts, from which the 125 volts is obtained, measured slightly high. It became immediately apparent the trouble was in the regulator circuit; Q215 was cut off.

Then I remembered something the factory man emphasized during a service meeting: the 250-volt supply is obtained by rectification from the horizontal sweep circuit. When this voltage is less than the regulating point of CR212 (135 volts), there is insufficient bias for Q214, therefore Q215 is cut off and there is very little voltage at the 125-volt supply.

On the other hand, if there is no voltage at the 125-volt supply, the horizontal can't operate, and the 250 volts is not generated. Each voltage supply depends on the other. Neither will operate unless something starts the cycle. That something is R336, which parallels Q215. It supplies enough voltage for partial operation of the horizontal sweep, permitting enough voltage on the 250-volt supply to enable CR212 to regulate the bias of Q214. Then the correct bias of Q214, in turn, enables Q215 to

(Continued on page 48)

(*Continued from page 47*)

conduct and bring the 125-volt supply up to normal. Up to the point where CR212 regulates, it's a regenerative cycle.

You guessed it, voltage at the 250-volt supply was very low, and R336 measured completely open.

Other causes of a small picture

Any parts defect which reduces the bias of Q214 also causes a small picture. These parts include R340, CR212, R341 and R342. Test these after you check the 250-volt supply.

Horizontal Squeal

A squeal can be produced by mechanical vibration at either 15,734 Hz (or some sub-multiple of the scanning frequency) of some horizontal-sweep component. Although there are other squeals that can originate in the sound channel and some that are radiated by the sweep circuit when it is defective, we are not concerned about those other types just now. The kind of squeals we are describing don't affect the performance of the television receiver.

In fact, many people can't hear sounds that are of such high frequency. Generally speaking, the older a person becomes, the more restricted is the high-frequency response of his ears. Of course, if the listeners can't hear the squeal, there is no problem.

Here are some of the components that can cause a squeal:

- tubes,
- focus controls,
- ceramic capacitors,
- focus rectifiers,
- high-voltage triplers,
- cores of sweep transformer or yokes,
- door cover or metal cage around the flyback transformer, and
- loose screws or missing chassis bolts.

Of these, flyback transformers and HV triplers seem to cause the most trouble.

If you can hear the squeal, try moving the various components using a long stick of bakelite or plastic. Elimination of the squeal when you touch a component usually means it is the one making the noise.

Squealing tubes usually are merely replaced. Sometimes the squeal can be stopped by applying a couple of rings of silicone rubber around the glass near the top and bottom mica wafers that hold the tube elements in place.

Flyback squeals

Tighten the mounting screws and any bolts that might be holding the assembly together. Sometimes this is enough to quiet the "singing".

A winding form that is loose around the core can be quieted by driving small wooden wedges in the space between.

A loose terminal strip can be tightened by using a glue or adhesive.

Small loose chips of core material can cause a noise far louder than you might imagine. A large missing piece of core material or a serious crack also is likely to affect the performance by giving less width and high voltage.

In some cases, shock mounting of the flyback using neoprene washers can quiet the transformer.

Check the door that opens into the high-voltage cage for tightness. Taping it around the edges sometimes works.

Other tips

A makeshift piece of test equipment can be constructed from a two-foot piece of stiff garden hose. Place one end against your ear and the other near the suspicious component, then listen. This also works quite well for finding certain kinds of popping noises in sweep components.

It isn't possible to be too specific in describing these remedies; each case is usually different. The idea is to try the methods one by one until you find one or two that work.

Some components, such as ceramic capacitors and HV triplers, often must be replaced, because they are sealed and can't be repaired. ☐

editorially speaking

THE CET MOVEMENT ROLLS ON

Notice that many of our authors now have CET (Certified Electronic Technician) following their names. Some of these are Joe Carr, Forest Belt, Robert Goodman, Jud Williams, and yes, even your editor, Carl Babcoke. Robert Goodman and I both took the exam at the joint Convention in August, and have received the good news that we passed. It gives a thrill to unpack that impressive certificate and realize what it signifies.

The staff of our magazine believes the CET program can and will be a tremendous force in the never-ending battle to upgrade our industry. The test is intended to be moderately difficult, for an easy test would cancel any sense of pride and accomplishment received from passing it. More than 5,000 men and women already have passed. Why don't you try?

We urge you to study, take the test, and join in a movement that cannot fail to help all of us.

Recommended as a textbook is the "Study Guide For CET Examinations", book number 20834 ($5.95), available from distributors of Howard W. Sams Photofacts. For CET test sites or additional information contact:

National Electronic Service
Dealers Association (NESDA)
1715 Expo Lane
Indianapolis, Indiana 46224
Phone: 317 241-8160

Important Addresses

Considerable confusion and delayed mail have resulted from misunderstandings of the many addresses found in Electronic Servicing. Because we are a subsidiary of Howard W. Sams, it is a natural mistake to assume we are in Indianapolis with the Book and Photofact Divisions.

Here in the magazine offices, we have virtually no service data, except that already available in the various Photofact publications. Therefore, send all your requests for service data not listed in Photofact Index direct to the Indianapolis address listed next.

Use this address for Sams Technical Books, Photofacts, and for service data not listed in the Index:

Howard W. Sams & Co., Inc.
4300 West 62nd Street
Indianapolis, Indiana 46268

To reach the editor of Electronic Servicing, write to:

Electronic Servicing
1014 Wyandotte Street
Kansas City, Missouri 64105 □

test equipment report

Features and/or specifications listed are obtained from manufacturers reports. For more information about any product listed, circle the associated number on the reader service card in this issue.

Tiny, Auto-Ranging Digital VOM

Product: Model 970A Digital Multimeter by Hewlett-Packard.

Features: This digital meter automatically selects the right range of the five for AC volts, DC volts or ohms. All electronic components, including the display and batteries, are in one small, hand-held package. There is only one function control to adjust, and only two input terminals. All solid-state switching is in one MOS integrated circuit. The readout uses a five-digit LED cluster to provide 3-1/2-digit accuracy. Decimal placement is automatic, there are no scales to misinterpret, and the polarity is indicated automatically. No current is drawn until the Push-To-Read bar is depressed, thus extending the useful life of the rechargeable batteries. Typically, less than two seconds are required for each reading. Nearness of the display to the circuit being tested increases the speed and accuracy of troubleshooting. The display can be electronically inverted to maintain accuracy of reading when it is desired to operate the instrument upside down.

Specifications: Input resistance of all voltage ranges is 10 megohms. Input of the probe is fuse protected. DC voltages from .1 volt full scale to 500 volts are read to an accuracy of ± .7% of reading ± .2% of range. AC voltages from .1 volt full scale to 500 volts over a frequency range of 45 Hz to 1 KHz are read to an accuracy of ± 2% of reading ± .5% of range. Accuracy of resistance measurements is ± 1.5% of reading ± .5% of range. About 2,000 Press-To-Read measurements can be made on one battery charge. A recharge takes 14 hours.

Size and weight: The 970A digital meter is 6-1/2 inches X 1-5/8 inches, and weighs 7 ounces.

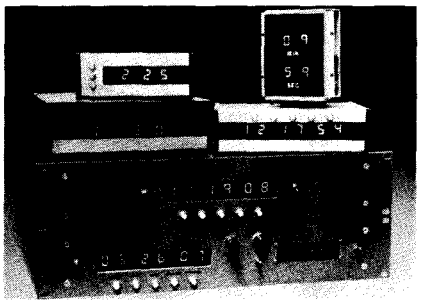
Price: Model 970A meter sells for $275, including a battery charger.

For More Details Circle (50) on Reply Card

Multimeter and Frequency Counter

Product: Digital multimeter and digital frequency counter from ESE Digitals.

Features: ESE Digitals offers a digital multimeter and 40-MHz digital frequency counter, completely assembled or available in kit form. Each instrument is designed as a low-voltage system. The digital read-out tubes are 7-segment type and all systems are completely solid-state. Crystal-base accuracy



controls are optional. Clocks and timers are synchronized to the 60-Hz line.

For More Details Circle (51) on Reply Card

Transistor Tester

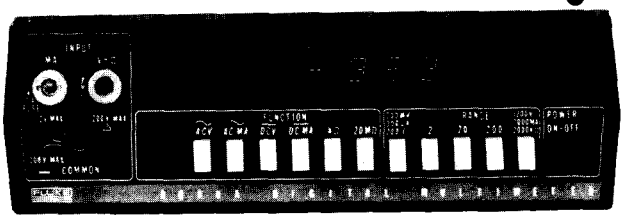
Product: Model 120 battery-powered transistor tester by Test-line Instruments.

Features: Model 120 determines in-circuit (or out) failures due to opens or shorts inside bipolar transistors. A pulse test checks transistors in low-impedance circuits such as found in power supplies, RF circuits, and regulators. When a good bipolar transistor is found, either a NPN or PNP LED is lit, indicating the polarity. The instrument is portable, includes rechargeable NI-Cad batteries, probe and cord.

For More Details Circle (52) on Reply Card

TO GET MORE INFOR-MATION

...on items advertised or described in this publication, use the Reader Service Card.



✻ Think of it as the best tester in your bag. Only $299

Now you can get a high performance Model 8000A Digital V.O.M. from Fluke, America's foremost maker of quality digital mutimeters, especially designed for TV, radio, stereo and audio service. No other digital V.O.M. gives you the resistance range to check breakers and switches, the high resolution voltage to look at emitter base and other transistor voltages, excellent ac accuracy and full accuracy with a 30 second warm-up.

Measures in 26 ranges 100 μV to 1200 V, 0.1 μA to 2A, and 100 milliΩ to 20 megΩ with a basic dc accuracy of 0.1%. Full year guarantee. Low cost options include rechargeable battery pack, printer output, deluxe test leads, HV, RF & 600-amp ac current probes, carrying case, and rack mount. Unique self zero eliminates offset uncertainty. Electronics securely mounted in high-impact case. Service centers throughout U.S., Canada, Europe and Far East for 48-hour turnaround repair.

FLUKE P.O. Box 7428, Seattle, Washington 98133.

Get all the details from your nearest Fluke sales office. Dial toll-free 800-426-0361 for address of office nearest you.

For More Details Circle (35) on Reply Card

Zo-o-o-o-m-m-m

First in the race. Raytheon put together the car. You drove it to top money in the big '72 season. It's a money-making team that started with your switch to Raytheon, the largest independent tube supplier. We know the competition is rough. As an independent serviceman, you can't waste time and money on call backs or pit stops. So, Raytheon builds to beat the competition. You drive hard for first place. And we're going for the trophy again this year. Together.

For More Details Circle (28) on Reply Card

catalogs literature

Circle appropriate number on Service Card.

100. AVA Electronics Corp.—has published a 1973 CATV, MATV connector price schedule featuring a comprehensive listing of "F" connectors. Each connector is illustrated with a picture. The schedule also illustrates a complete listing of UHF and BNC connectors.

101. Belden Corporation—offers a line of wire and cable products for use in alarm/security systems. Included are products for closed-circuit television (CCTV), digital dialing, alarm controls, central stations, photoelectrics, power supplies, telephone dialers, intrusion sensors, access controls, sirens, bells, horns, paging, audio detection, emergency lighting, and scanners.

102. Cornell-Dubilier Electronics—has issued a 1973 replacement guide for electrolytic twist-prong capacitors. The guide lists 276 CDE capacitors which can replace 97% of all the twist-prong units now in service (estimated to be over 25,000). The 56-page brochure tabulates the capacitors in three ways; by catalog number, OEM number (manufacturer's name) and by ratings.

103. GC Electronics—offers the Audiotex Catalog FR-73-A which lists everything necessary for proper care and maintenance of sound equipment, a complete assortment of security alarms and accessories, and antennas and installation hardware.

104. GTE Sylvania—has published an ECG semiconductor guide which gives replacement information for nearly 80,000 solid-state devices. The first 32 pages of the 148-page illustrated catalog give electrical characteristics and mechanical specifications for all industrial and commercial components in the ECG line. The remaining pages cross-reference almost 80,000 foreign

and domestic types, in alphanumeric order, to the equivalent ECG devices.

105. Hitachi Sales Corporation of America—presents a compilation of audio basics written to be used by retail salesmen. It's a primer and introduction to the most commonly used audio terms. Complete with definitions, illustrations, and diagrams, it runs the gamut from "acoustic suspension speaker" to "woofer and wow". A special feature is a clear explanation of the various systems for 4-channel sound.

106. International Rectifier Corp.—offers the 1973 Semiconductor Cross-Reference and Transistor Data Book. The 72-page cross-reference uses straight alphanumeric listing and includes rectifiers, capacitors, zeners, transistors, SCRs and ICs (chips). The book shows IR transistor specifications and case diagrams, and also contains an "exact replacement" IC data sheet.

107. Kay-Townes, Inc.—introduces a 16-page short-form MATV/CATV catalog and price list. The new catalog contains complete specifications on the "New Reliables" line of equipment, listing over forty additional products.

109. Littelfuse, Inc.—has an eight-page cross-reference catalog that lists the comparable Littelfuse and Bussman parts for hundreds of standard fuses, fuseholders, fuse clips, and fuse blocks. A comprehensive array of voltages, amperages, and fuse types, including indicating fuses, delayed or "slow blow" fuses, miniature types, high voltage, limited current fuses, rectifier blocks, fuse blocks, fuse clips and fuse holders, is identified and cross-referenced. □

audio systems report

Features and/or specifications listed are obtained from manufacturers reports. For more information about any product listed, circle the associated number on the reader service card in this issue.

Speaker System

Product: MP-2000 three-way tuned-port speaker system from Utah Electronics.

Features: Bass octaves are reproduced within 2.5 dB by the woofer which features a long-throw, four-layer high-temperature voice coil, a 4-pound ceramic-magnet drive assembly, and viscous-damped fabric suspension. An acoustically isolated 5-inch mid-range unit with chemically treated cloth rolls, and a 1-inch horn-loaded phenolic dome radiator gives response to 20,000 Hz. A variable control permits adjusting the response to match room acoustics. Rated response is 30-20,000 Hz; the MP-2000 can take 60-watt power peaks without audible distortion.

Size: The dimensions are 15-1/4 X 24 X 12 inches.

Price: MP-2000 is priced at $139.95.

For More Details Circle (54) on Reply Card

Special-Environment Loudspeakers

Product: Models WT15, WT-15T and WT-30T speaker systems from Atlas Sound.

Features: Full-frequency-range reproduction of music and voice at high power is a feature of three coaxial outdoor-indoor reflex speaker systems. Each unit offers individual weatherproof woofer, crossover network, and compression driver. Power rating for model WT-15 is 15 watts, frequency response 150-15,000 Hz and sound level 117 dB; for model WT-30T power rating is 30 watts, frequency response 100-15,000 Hz and sound level 120 dB. Features of models WT-15T and WT-30T include a built-in matching transformer, and the flexibility of selecting impedance or wattage with a screwdriver via a front-access switch.

For More Details Circle (55) on Reply Card

□

Statement of Ownership, Management and Circulation, Act of August 12, 1970; Section 3685, Title 39, United States Code.

1. Title of Publication: Electronic Servicing
2. Date of Filing: September 28, 1973
3. Frequency of issue: Monthly
4. Location of known office of publication (Street, city, county, state, zip code): 9221 Quivira Road, Shawnee Mission, Johnson County, Kansas 66215.
5. Location of the headquarters or general business offices of the publishers (not printers): 1014 Wyandotte St., Kansas City, Jackson County, Missouri 64105.
6. Names and addresses of publisher, editor, and managing editor: Publisher, Robert E. Hertel, 1014 Wyandotte St., Kansas City, Missouri 64105; Managing editor, Carl Babcoke, 1014 Wyandotte St., Kansas City, Missouri 64105.
7. Owner (if owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual must be given.) Howard W. Sams & Co., Inc.—a wholly owned subsidiary of International Telephone and Telegraph Corporation, 320 Park Ave., New York, New York 10022.
8. Known bondholders, mortgages, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages or other securities (If there are none, so state): None.
9. Paragraphs 7 and 8 include, in cases where the stockholders or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner. Names and addresses of individuals who are stockholders of a corporation which itself is a stockholder or holder of bonds, mortgages or other securities of the publishing corporation have been included in paragraphs 7 and 8 when the interests of such individuals are equivalent to 1 percent or more of the total amount of the stock or securities of the publishing corporation.
10. This item must be completed for all publications except those which do not carry advertising other than the publisher's own and which are named in sections 132.231, 132.232, and 132.233, postal manual (Sections 4355a, 435b, and 4356 of Title 39, United States Code).

	Average No. Copies Each Issue During Preceding 12 Months	Single Issue Nearest To Filing Date
A. Total No. Copies Printed (Net Press Run)	69,091	71,206
B. Paid Circulation		
1. Sales through dealers and carriers, street vendors and counter sales	4,629	4,617
2. Mail Subscriptions	59,950	61,635
C. Total Paid Circulation	64,579	66,252
D. Free Distribution (including samples) by Mail, Carrier or Other Means	1,249	690
E. Total Distribution (sum of C and D)	65,828	66,942
F. Office Use, Left-Over, Unaccounted, Spoiled after Printing	3,263	4,264
G. Total (sum of E and F—should equal net press run shown in A)	69,091	71,206

I certify that the statements made by me above are correct. (Signature of editor, publisher, business manager, or owner).

ROBERT E. HERTEL

photofact™ bulletin

Photofact Bulletin lists new **Photofact** coverage issued during the last month for new TV chassis.

BRADFORD
1171C23 (WTG-90019) 1345-1

CURTIS MATHES
5G198 (Ch. C-51, CMC-51) 1346-1

DUMONT
25DC10W, 25DC11S, 25DC12M 1353-1

EMERSON
Chassis 32K1673-35, 32K1687-4 1350-1

GENERAL ELECTRIC
Chassis UA 1353-2

J. C. PENNEY
4897A/B, 4922A/B, 4923A/B 1351-1

MAGNAVOX
Chassis T969-01-AA 1347-1

MGA
CS-130 1347-2

PANASONIC
CT-301 1346-2

PENNCREST
2858 (685-2858) 1350-2

PHILCO-FORD
Chassis 3CS90, 3CS91, 3CY90, 3CY91 1344-1

RCA
AS193W (Ch. KCS186D) 1343-2

RCA
ES354E/Y (CH. CTC62A) 1345-2

RCA
Chassis KCS185F 1348-2

SEARS
528.43520200 thru 528.43520216,
528.43530200 thru 528.43530216,
528.43531200 thru 528.43531210 1352-2

SYLVANIA
Chassis B10-7 thru B10-13 1350-3

TELEDYNE PACKARD BELL
2M621BG, 2M623WL 1352-3

WARDS AIRLINE
GCI-17422A/22B/42A/42B/52A/52B,
GCI-17522A/22B/42A/42B/52A/52B,
GCI-17822A/22B/32A/32B/42A/42B/52A/52B,
GCI-17922A/32A/42A/52A 1344-2

ZENITH
Chassis 16DB12X (Late Prod.) 1346-3

The MARKETPLACE

This classified section is available to electronic technicians and owners or managers of service shops who have for sale surplus supplies and equipment or who are seeking employment or recruiting employees.

Advertising Rates in the Classified Section are:

- 25 cents per word (minimum $3.00)
- "Blind" ads $2.00 additional
- All letters capitalized 35 cents per word

Each ad insertion must be accompanied by a check for the full cost of the ad.

Deadline for acceptance is 30 days prior to the date of the issue in which the ad is to be published.

This classified section is not open to the regular paid product advertising of manufacturers.

FOR SALE

TV & RADIO TUBES 36c EA!! Free color catalog. Cornell, 4221 University, San Diego, California 92105 4-73-tf

UNUSUAL SURPLUS electronics and parts catalog, thousands of items. $1. ETCO, Dept. ES. Box 741, Montreal, Canada. 2-73-10t

REPLACEMENT TRANSISTORS up to 75% below **Dealer Net!** Send for details. Kenneth E. Hull C.E.T., 835 Halesworth Dr., Cincinnati, Ohio 45240. 10-73-2t

FOR SALE (Cont.)

AMAZING, Automatic, diagnostic, dial-a-fix is guaranteed to save you on your T.V. repairs. $3. Paul Tayo 980. Greene Avenue, Brooklyn, N.Y. 11221. 11-73-3t

PHILCO AUTO RADIOS (1969-1974) audio network, 3L5-0002-01. $1.75 each or 6 or $10. BZ Enterprises, 6920 7th North St. Liverpool, N.Y. 13088. 11-73-3t

NEW CONDITION TEST EQUIPMENT: HEATHKIT IG57 TV SWEEP GEN $125. HEATHKIT IM25 LAB TYPE VOM $95. HEATHKIT IP25 L.V. SUPPLTY $85. DATA INSTRUMENTS 555 SOLID STATE TRIGGERED 7MHZ OSCILOSCOPE $255. SEND CERTIFIED CHECK F.O.B.: APPLIED VIDEO ELECTRONICS, INC., BOX 25, Brunswick, Ohio 44212 10-73-2t

USE YOUR SCOPE (ANY MODEL, NO REWIRING) TO TEST TRANSISTOR IN/OUT CIRCUIT. SIMPLE ISTRUCTIONS $1.00. SCHEK TECHNICAL SERVICES, 8101 SCHRIDER ST., SILVER SPRING, MARYLAND 20910. 10-73-12

SERVICE

"NOW YOU DON'T HAVE TO throw-away that good old piece of equipment because of a transformer. Send us the old transformer and we will re-wind it. May cost less than buying a new one. Power transformers, modulation, vertical, audio, etc. etc. Any kind. Any size. Televideo Communication Lab., 380 E. 14 St., Hialeah, Fla. 33010". 10-73-1t

EDUCATION INSTRUCTION

REPAIR TV TUNERS—High Earnings; Complete Course Details. 12 Repair Tricks, Many Plans. Two Lessons, all for $1. Refundable. Frank Bocek, Box 3236 Enterprise, Redding, Calif. 96001. 9-73-7t

WANTED

ELECTRONIC TECHNICIAN FOR AUTO RADIO SERVICE SHOP IN PHILADELPHIA, PA. AREA. MUST BE TOP BENCH MAN THAT KNOWS OR CAN SWING INTO AUTO RADIO AND TAPE UNITS. SOME BUSINESS ABILITY FOR POSSIBLE TAKE OVER OF SHOP. RIGHT MAN $250-$300 WEEK. NO NIGHTS 5½ DAY WEEK. MAY PAY YOU TO RELOCATE GREAT OPPORTUNITY FOR GOOD MAN WITH AN OLD ESTABLISHED BUSY SHOP. SEND RESUME TO: BOX 503, ELECTRONIC SERVICING, 1014 WYANDOTTE ST., KANSAS CITY, MO. 64105. 11-73-1t

advertisers' index

"IT WAS FANTASTIC: WHEN THE YELLOW PAGES CAME OUT, BUSINESS ALMOST TRIPLED."

Michael A. Cozzolino, A&M TV Sales and Service, Alameda, California

Doreen and Michael Cozzolino

"My wife Doreen and I have
s re learned lot in o r 2 e s in
i ," l . li .
" i i l i i
ll . l li ,
l i i l i
ll . l
. i ' ,
, i ')
i .
' i i
i , : l l ' i l .
l li l i i . l i
ili i il i . l li
l , l i l
i i li i . l j i
i i l i i i
i .
, , ll i l -
i . ' i li
i i i i " .

The Tuner People

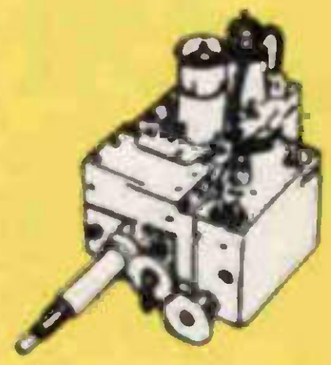
Pioneers of TV Tuner Overhauling
Originators of Complete TV Tuner Service

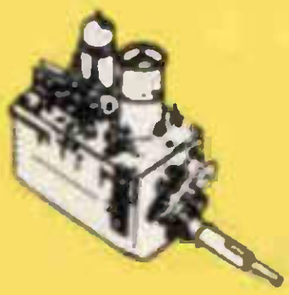
Castle offers the following services to solve ALL your television tuner problems.

Universal Replacements from $8.95

These universal replacement tuners are all equipped with memory fine tuning and uhf position with plug input for uhf tuner. They come complete with hardware and component kit to adapt for use in thousands of popular TV receivers.

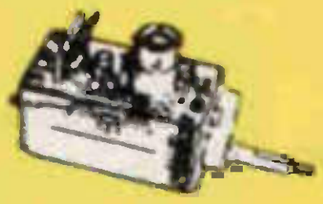
STOCK No.	HEATERS	SHAFT Min.*	SHAFT Max.*	I.F. Snd.	PRICE
CR8P	Parallel 6.3v	1¾"	3"	41.25	8.95
CR7S	Series 600mA	1¾"	3"	41.25	9.50
CR8S	Series 450mA	1¾"	3"	41.25	9.50
CR6XL	Parallel 6.3v	2½"	12"	41.25	10.45
CR7XL	Series 600mA	2½"	12"	41.25	11.00
CR8XL	Series 450mA	2½"	12"	41.25	11.00





Castle Replacements $15.95

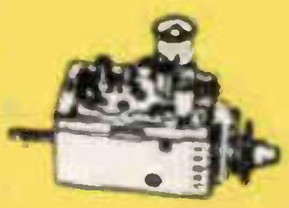
Castle custom replacements made to fit in place of original tuner. Purchase outright . . . no exchange needed. Write for current list of Castle replacements, or request the part number you require (use number on ORIGINAL TUNER ONLY; do not use service literature numbers). Available for many of the popular models of following manufacturers: Admiral, Curtis Mathes, Emerson, GE, Heathkit, Magnavox, Motorola, Muntz, Philco, RCA, Sears, Sylvania, Westinghouse, Zenith and many private labels.



Tandem uhf-vhf replacements NOW $21.95

Available in popular models of: Muntz, Olympic, Philco, Sears, Westinghouse and private labels.

Overhaul Service $9.95

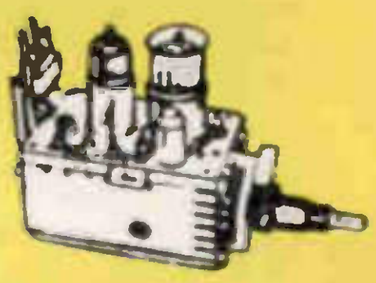


This is the service pioneered by Castle! We are now in our third decade of serving the TV Service Industry

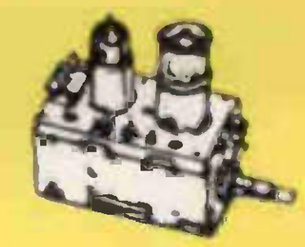
Service on all makes and models, vhf or uhf, including transistor and color tuners . . . one price $9.95 (does not include tuners older than 10 years). Overhaul includes parts, except tubes and transistors.

Simply send us the defective tuner complete; include tubes, shield cover and any damaged parts with model number and complaint. Your tuner will be expertly overhauled and returned promptly, performance restored, aligned to original standards and warranted for 90 days.

Dismantle tandem uhf and vhf tuners and send in defective unit only. Remove all accessories . . . or dismantling charge may apply.

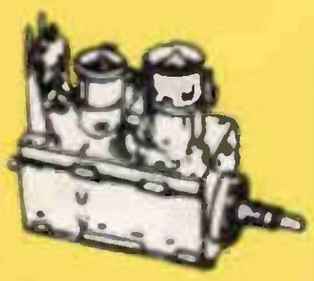


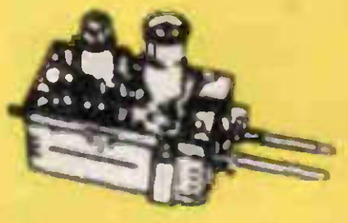
Custom Exchange Service $17.95



When our inspection reveals that original tuner is unfit for overhaul, and it is not available from our stock of outright replacements, we offer to make a custom replacement on exchange basis. Charge for this service is $15.95 for uhf tuner and $17.95 for vhf tuner.

If custom replacement cannot be made we will custom rebuild the original tuner at the exchange replacement price.





All replacements are new or rebuilt. All prices are f.o.b. our plant. Add shipping and handling of $1.25 on all prepaid orders. We will ship C.O.D.

CASTLE TV TUNER SERVICE, INC.

5701 N. Western Ave., Chicago, Ill. 60645 • Ph. 312—561-6354

For More Details Circle (2) on Reply Card