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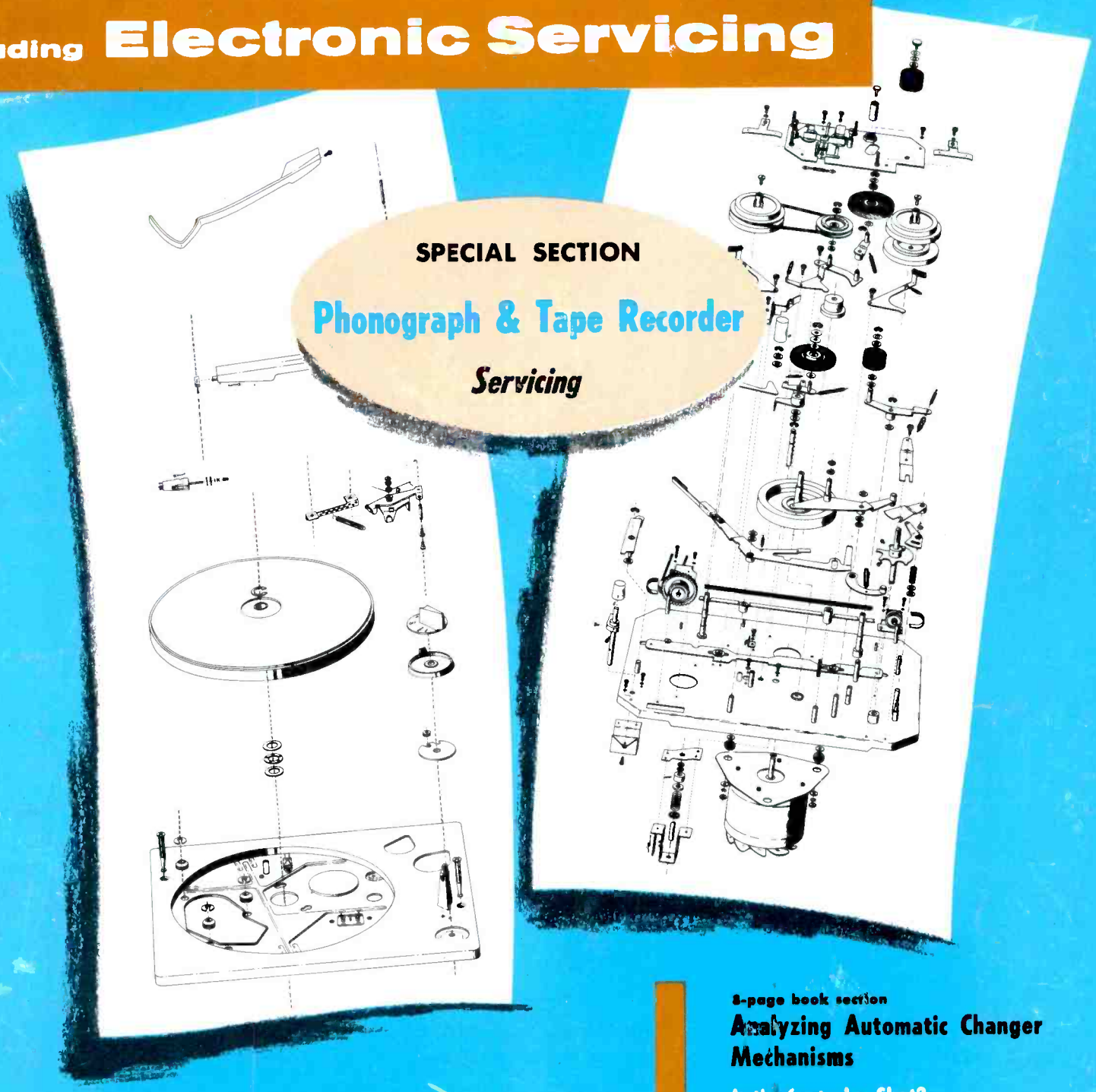

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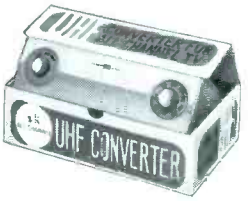

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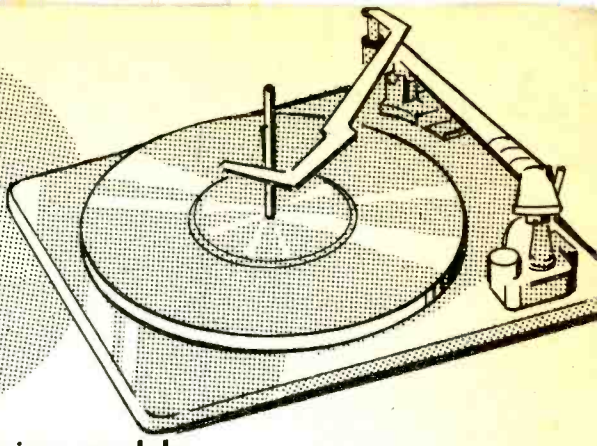

How to trace the sequence of action in various models.

by Forest H. Belt

Record-changer servicing is a segment of the electronics business that seems to grow with each passing year. Record changers just keep on increasing in numbers, and are seemingly destined to be around for years to come. Too, they have seen countless improvements through the past several decades, and have enjoyed steadily increasing popularity through all these years of development. By its very numbers, the record changer is an important part of the electronics business. And servicing these units can be a very rewarding undertaking for any service technician.

Basically Simple

There are some servicemen who don't want to bother with record changers. They offer various excuses, and find countless reasons for turning down changer jobs; the *true* reason is generally that they don't thoroughly understand the mechanical operation. If this is why *you* don't service changers, or accept them only grudgingly, you're missing a good bet. Changers are not really that complicated. They can be analyzed as a chain of operations, exactly as you analyze an electronic circuit that performs certain definite functions. If you can analyze *one,* you can learn to apply the same sort of reasoning to any other. Thus, with a little familiarization, you can become expert in a very short time.

All record changers have one thing in common: their purpose. They must drive a turntable at a predetermined speed to "spin" the records, provide a support for holding unplayed records, and drop the records one at a time as each is played. In the latter process, the tone arm must be raised clear of those records on the turntable and moved out of the way of dropping records, placed back in the starting groove no matter what the record diameter, and returned to a resting position when the last record is played. No matter what brand or style of changer you encounter, you'll find all these functions are provided. The only real difference lies in the means used to perform each function.

More elaborate changers include accessories that make them seem more complicated. Vacuum cleaners on the tone arm endeavor to keep the record clean. Stylus brushes either "sweep" the record or brush across the stylus during the change cycle. Leveling devices show the operator when his turntable is precisely level. The important point for you to remember is that none of these accessories should confuse the basic issue—servicing the changer mechanism. Just as you ignore many of the circuits in a television receiver, and look for a fault in only the stages where trouble is suspected, you can learn to analyze a record changer in the light of only that section which is malfunctioning. Let's look at some of the "stages" of a changer mechanism, and see just how *mechanical troubleshooting* is done.

The Primary Functions

The "stages" of a changer mechanism are divided into certain primary functions, just as there are sections of a television set for various purposes. Fig. 1 shows a block diagram of the interdependence between various sections of a record-changer mechanism. Remember these "stages," and understand the need for each; they are the building blocks for a thorough knowledge of changers.

The turntable-driving device is probably the most important, for all other functions usually depend upon rotation of the turntable. As it goes around, it actuates and drives various slides, gears, wheels, and cams to initiate each of the record-changing functions. Thus, the very first step in servicing a troublesome changer is to make sure the turntable is being driven firmly, freely, and smoothly. Many seemingly unrelated complaints can be traced to turntable drive faults, as you will see presently.

Next in sequence is the trip mechanism. The trip can be actuated manually by a "reject" switch or automatically at the end of each record by the tone arm. In Fig. 1, note the "feedback" loop from the tone arm to the trip device. The automatic-manual switch is pro-

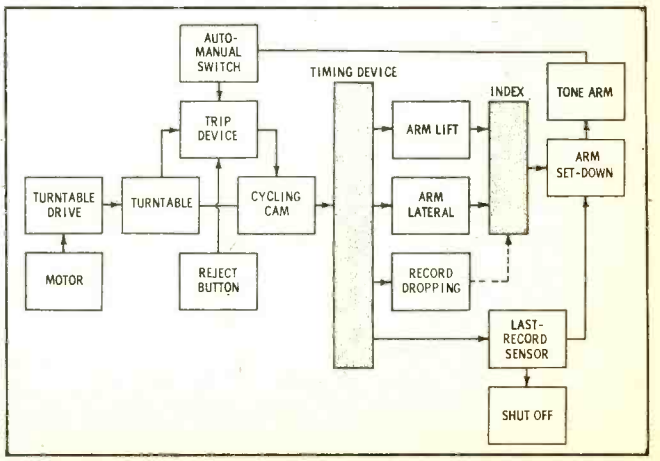

Fig. 1. Block diagram of changer mechanism shows sequence of functions, same as a similar diagram for electronic circuit.

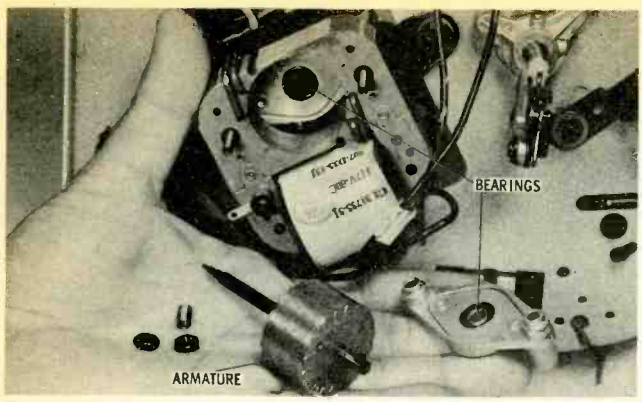

Fig. 2. Changer motors of two-pole variety are easily disassembled for repairs or cleaning. Note bearing for each end.

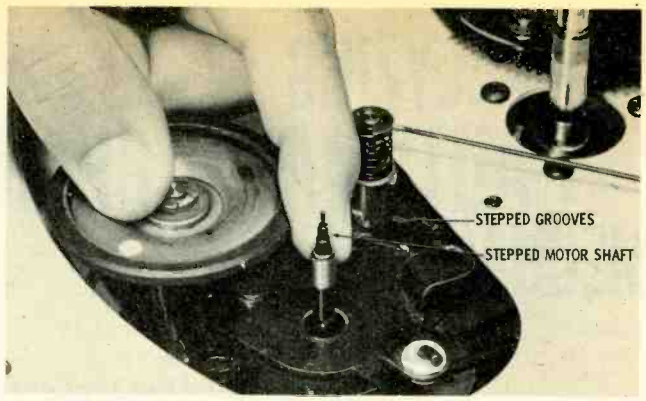

Fig. 3. Stepped motor shaft for changing speeds. Note idler plate raised and lowered by moving over stepped grooves.

vided in some changers to disable the "feedback" loop (which is a mechanical linkage), bypassing the automatic action of the changer mechanism.

The trip device is merely a means for starting the cycling cam into operation. It is the cycling cam that actually drives each of the various cycling functions, usually through a timing device of some sort that determines the exact sequence of operations.

In most machines, a sensing device determines when the last record is dropped. When no more records remain on the support, the end of the change cycle is altered—the arm sets down on its rest instead of on a record, and usually the machine shuts off.

The chart in Fig. 1 can be an excellent troubleshooting aid. Suppose you want to do a thorough job on a record changer, carefully checking all operations. Start at the left and work your way to the right across the chart, checking each operation in the changer you're servicing. So you'll know what to expect in each "stage," let's go over each one in detail. Different models use different mechanisms to perform each function, and you will want to understand all the basic types. At the same time, we'll discuss typical trouble symptoms and cures.

Turntable Drive Systems

For discussion purposes, and for troubleshooting, we prefer to subdivide the drive system into its major parts: the motor, the speed-changing device, and the actual drive components. Each part has its own characteristics and troubles, and each varies from model to model.

Changer Motors

Expensive changers frequently use the costly *hysteresis synchronous* motor. These motors seldom cause hum in the changer pickup circuits, because of their construction. Since they are sealed, repairs are impractical. Should one of these motors become noisy, or vibrate too much, it is wise to replace it without hesitation. The changer that uses one of them is undoubtedly a high-quality unit, and the owner is not so likely to quibble over cost if it means perfect operation.

In many of the medium-priced changers, the *shaded four-pole* motor is quite popular. This unit is relatively free from stray hum fields, at least compared with its less expensive two-pole counterpart. It normally runs quite smoothly, with little "chatter" of either the laminations or the armature. Trouble usually occurs when a bearing becomes defective, or a winding opens. If excessive vibration occurs, simply replace the unit, for repairs are seldom worthwhile. Some of these motors use shielding that makes access difficult.

The simple *two-pole* motor has been found satisfactory for most changers, and is popular because of its price. Modern designs and shielding have produced units that are far more hum-free than older units of this type. Also, with the advent of ceramic and similar types of high-fidelity cartridges, hum pickup has been reduced; hum trouble was most noticeable when a two-pole motor was used in a changer with a magnetic or moving-coil type of cartridge.

Two-pole (and some four-pole) motors use an open type of construction, making them prone to accumulate dust in the armature over a period of months or years. Too much accumulation causes sluggish operation and loss of power; a few will become so dirty as to stall during the change cycle or refuse to start the turntable without a "push." The motors can be easily disassembled, as shown in Fig. 2, and cleaned thoroughly with alcohol. During reassembly, a very small amount of solid (wheel-bearing) grease can be added to each end bearing; beware of oil, for it will simply run down into the motor, hastening the dust accumulation.

Speed Control

This device is easily found in most changers, as it is connected to the speed-change switch—which is readily visible. In some systems, the switch is connected via a mechanical linkage to a small plate that carries three (four, in a four-speed unit) idler wheels or pulleys of differing sizes. Shifting the switch moves the proper idler into contact with the other turntable-driving components, providing a drive ratio that produces exactly the speed desired.

Another speed-control system uses a stepped idler wheel. When the speed lever is moved, the speed-idler mounting plate moves over a stepped section of the main deck plate; this moves the idler wheel up or down, and places the proper step in contact with the driving wheel.

The most popular modern system is similar, except that the motor shaft is stepped instead of the drive idler—see Fig. 3. The speed-change lever merely moves the idler plate over stepped grooves on the main deck, raising or lowering the idler to the proper step on the motor shaft.

A few elaborate changers provide means for varying the speed smoothly instead of in steps, or for "fine-tuning" the speed to precise accuracy. This is done by means of a tapered idler, over the surface of which

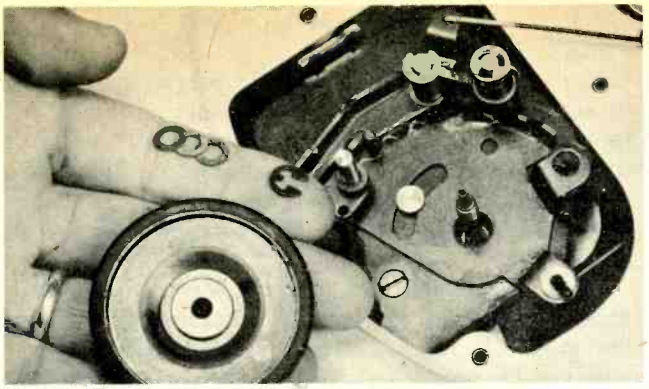

Fig. 4. Removing idler wheel from its shaft (near index finger) is simple matter of pulling clip. Note the washers.

Fig. 5. Velocity trip system, with arm and pawl. Below the changer deck, motion of tone arm is transmitted to trip arm.

the drive wheel can be moved to change the drive ratio and vary the speed.

From a troubleshooting standpoint, about the only things that normally happen to the stepped type of speed control are slippage or misalignment. Alcohol cleaning will take care of the former. Misalignment can be caused by a bent speed-idler mounting plate, a bent stepping plate, a bent or broken stepped idler, or a bent motor shaft. In many cases, careful straightening can effect a cure; in others, replacing the warped component is the quickest and most dependable repair.

In the continuously variable speed control, slippage is the most troublesome fault. Since they are usually made of rubber, hardened or deteriorated tapered idlers might cause the trouble, in which case a replacement is necessary. In most, however, a thorough alcohol cleaning will stop any slippage.

Turntable Drives

There are only two basic drive mechanisms used in modern changers—idler-wheel and belt drives. The simplest of these is the idler wheel that is held against the motor drive shaft and in contact with the inner rim of the turntable. As the motor turns, the idler turns, and drives the turntable.

Other, more elaborate idler drives use one or two intermediate idler wheels, particularly where several speeds are involved. One of the idlers between the motor shaft and the turntable may be the speed idler mentioned earlier. No matter how many idlers are used, the sequence is easy to trace, and troubleshooting steps that apply to one idler apply to all.

You'll encounter a few idler drive systems in which the idler contacts the turntable on the underside of its flat surface, instead of on the rim. Actually, this makes no difference whatsoever in analyzing or servicing the system, for the same principle applies to these as to other drive mechanisms.

Somewhat different from the idler-wheel arrangement is a system that is popular in more expensive changers—the drive belt. Using a belt drive seems to eliminate the effects of age on the speed of a machine, for the drive pulleys are metal and cannot shrink or develop flat spots; thus, the drive ratios are kept constant.

The motor shaft drives, through a rubber belt, another pulley which supports a second belt. The second belt usually drives the speed idlers, or a stepped speed idler. The speed idler transmits energy to the turntable through a drive idler. Thus, you see, even the belt arrangement is something of a hybrid system. In very rare cases, a belt drives the turntable directly from the speed pulley.

In a few older sets, you may find a turntable that is gear-driven. This is rarely seen nowadays, and is barely worth mentioning. If you encounter one, it should be little problem to trace the gear train.

Drive systems are early victims of age, as a rule. Oil seeps onto the drive surfaces, causing slippage. Rubber surfaces become hard, cracked, and brittle, causing variations in turntable speed (wow) and frequent stalling in cycle. Dirt can build up inside the center holes of idler wheels, causing sluggish action and resultant stalling.

A common occurrence in some models is the "bumpy" idler wheel, which causes "wow" in the sound. A flat spot may be pressed into a rubber idler wheel when it is left in contact with another idler wheel or shaft for extended periods. When the idler revolves, the bump causes a rise and fall in the speed of the turntable. Many changers disengage the idlers when the unit is "off," eliminating this problem.

"Bumpy," cracked, or brittle idler or drive wheels must be replaced, whether they are on the speed-change plate or driving the turntable. Each good idler should be removed from its shaft and cleaned thoroughly with alcohol, and the mounting shaft cleaned. (Most idlers can be removed easily by pulling a clip—as in Fig. 4.) A small piece of sandpaper rolled up and inserted a few times in the hole of the idler wheel will remove any metal filings that might cause binding.

Remember, at least 90% of the troubles that affect turntable speed, or cause stalling of the changer during its cycle, can be traced to slipping or binding in the drive mechanism. So, whenever you are servicing a changer for any reason, be sure to clean all the drive parts thoroughly—including the turntable drive surface. And if any of the parts are warped or bent, or if any of the rubber surfaces are brittle or cracked (even a little), replace them. You'll be adding callback insurance that you can't buy as cheaply in any other type of electronics servicing. The cost is low in time and material, and the dividends are enormous.

Trip Mechanisms

The trip mechanism used in most modern changers

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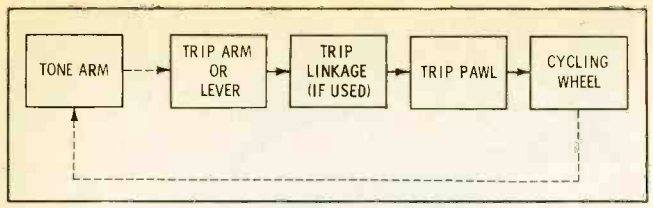

Fig. 6. Action diagram indicates how each part of tripping assembly actuates next operation, begun by arm movement.

is the velocity type. This arrangement has been used in one form or another for quite a few years, but some manufacturers have incorporated other types in their changers. Even in models that used a form of electrical tripping, the velocity trip was used to initiate the electrical action.

Velocity trip action draws its name from the sudden increase in tone-arm tracking velocity when the needle enters the eccentric leadout groove in the center of a record. As the tone arm follows the *modulated* grooves of a record, a trip arm (see Fig. 5) follows the movement of the tone arm. As the tone arm nears the center of the record, the trip arm (sometimes connected to a trip linkage) nudges a trip pawl. This nudge is very slight, and a slight projection on the turntable hub pushes the pawl back with each revolution of the turntable.

As the tone arm enters the leadout groove, the trip arm and link push the pawl quickly, since the leadout groove moves the arm rapidly toward the center post. The quick movement of the pawl places it against the turntable hub before one revolution has a chance to push it back. The hub projection catches the trip pawl firmly this time, pushing the change cycle wheel (or cam) into mesh (or center) with the turntable. The turntable then proceeds, by gear or friction, to drive the cycling wheel through its cycle and back to the rest position—where it waits to be tripped at the end of the next record. The tone arm, meanwhile, moves the trip arm back to the starting point where it starts over.

All parts of a velocity trip mechanism must be completely free of oil, dirt, or grease—anything that could even slightly hamper free movement. A common complaint is constant tripping, where a changer just continues to cycle without pausing to play any of the records; a sticky or bent trip link or pawl is the most likely cause. A thorough cleaning with alcohol (disassembling if necessary to reach all parts) is the solution to sticky parts. Replacement is the only practical cure if a part is bent—straightening is both time- and patience-consuming.

If a changer fails to trip, there are several possible causes. The best troubleshooting procedure is a step-by-step check of the tripping mechanism—see the troubleshooting block diagram in Fig. 6. First, make sure the trip arm (and linkage if used) is moving toward the trip pawl as the tone arm moves across the record.

Next, see if the trip pawl works correctly, being nudged backward with each revolution until the lead-out groove is reached. Then it should swing quickly with the tone arm and trip linkage, being pushed all the way in to the hub. If it fails in this quick swing, the trip arm may be too loose; some changers have an adjustable collar that sets the friction for the trip arm, while others depend on the friction caused by a bent spring washer. In the latter systems, replacing the washer may be necessary to get just the right amount of friction—neither too tight nor too loose.

If the trip pawl works, make sure the projection at the hub of the turntable engages it the next time around. It not, perhaps the pawl is bent so it still fails to engage the projection. If you try straightening it, be sure you don't cause other trouble by going too far. Replacement is always more sure to effect a permanent cure.

Lastly, be sure the cycling wheel is positioned—at its resting point—so the pawl can push it into mesh with the gears (or into contact with the turntable hub, if a cam is used). Make sure its stop point is "timed" properly so it comes to rest at the proper point during the change cycle.

Careful analysis of the action of each step outlined in the chart will reveal any deviation from normal operation. And if you'll follow that hard-and-fast rule—*keep oil and grease off all changer drive and trip parts, cleaning with alcohol when necessary*—you'll have little trouble keeping changer trip systems operating.

Change Cycle and Timing

All the actions that occur during the automatic record-changing cycle are powered by the turntable, through a drive wheel or cam (not to be confused with the turntable drive idlers) called either the cycling wheel or cycling cam. A gear wheel is used most frequently nowadays, but some changers still use the rubber-tired cycling cam. The cycling cam very often

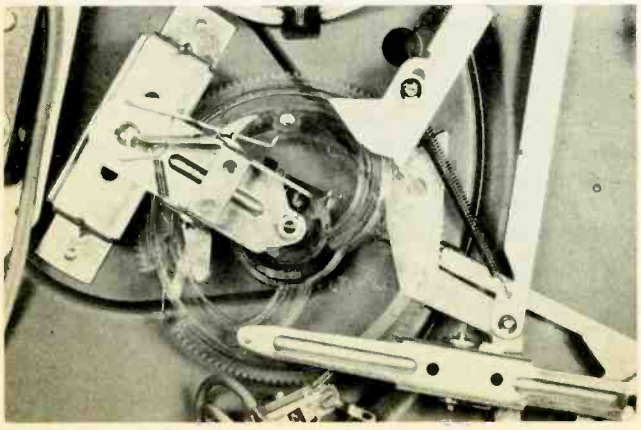

Fig. 7. Grooved timing (cycling) wheel actuates number of levers, arms. Many units use metal wheel instead of plastic.

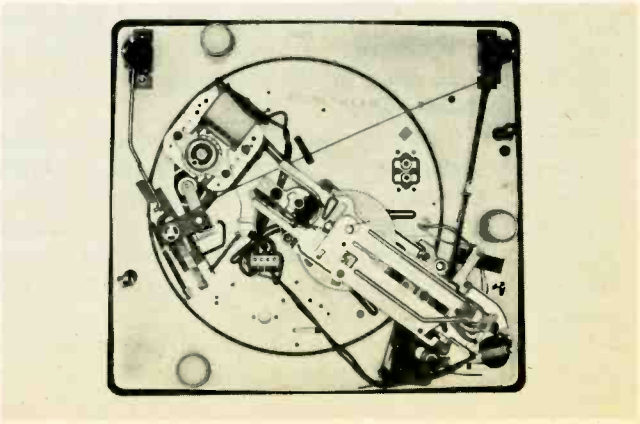

Fig. 8. Timing slide is used in a number of changers in place of cycling wheel. Slide is driven by a cycling cam.

drives a timing slide mechanism, which we'll discuss presently.

Whatever the form taken by the drive wheel, it is engaged with the turntable by the trip mechanism, and its job is to furnish drive energy for the various actions that take place during the change cycle.

The change cycle itself is probably the least understood part of record-changer operation. This is because it consists of a large number of almost simultaneous actions: the arm is raised, moved laterally in two directions, and set down; records are dropped; the arm is indexed to the proper setdown point; the trip mechanism is reset; a sensor indicates whether there are any more records to be played, and if not, a shutoff mechanism turns the machine off. Each of these operations must all occur at precisely the correct instant, or one action will "get in the way" of another. Keeping these actions happening at exactly the proper point in the change cycle is the function of the timing wheel or slide. Sometimes timing is a function of the cycling wheel, with special grooves initiating the various actions (see Fig. 7). In several modern changers, timing is handled by a timing slide—often called the cycling slide—shown in Fig. 8. In some, timing is taken care of by sequential operation of various parts, with one action initiating operation in another section; Fig. 9 shows a changer of this type, with part of the cycling mechanism above the deck and part below.

Instead of trying to analyze an entire change cycle at once, look at one specific function at a time, tracing only the actions of that particular phase. Fig. 10 shows how the change cycle is organized. Remember that each operation is initiated by some function of the timing mechanism; if an operation depends on a prior action, it is necessary to follow the entire sequence. But in most cases, you can analyze one phase at a time. Let's examine each phase, and see how it is accomplished.

Arm Lifting

Since this is the first step in the change cycle, we'll consider it first. The idea of this action is to lift the tone arm clear of the record so the stylus will not drag when the arm moves sideways or laterally.

One of the most common methods uses a push rod that slides up and down inside the hub or spindle of the tone arm. Underneath the changer deck, a raised portion (riser) of the timing wheel or slide slips under the tip of the push rod, shoving it upward through the

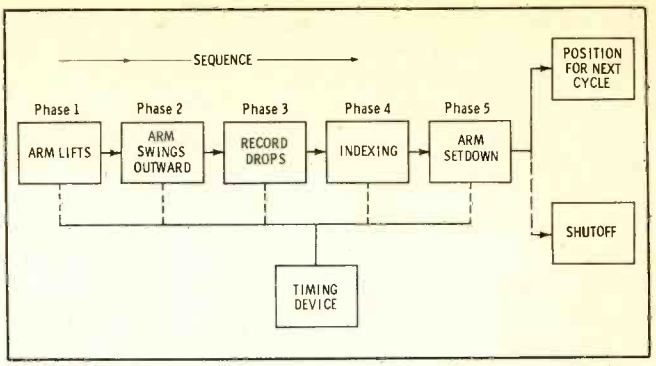

Fig. 10. Functional sequence of change cycle, as initiated by the timing device. Each function can be analyzed separately.

tone-arm hub. It strikes a plate in the base of the tone arm, raising the entire arm on its vertical pivots. If it fails to work, the cause may be a bent or improperly positioned plate (an adjustable screw is sometimes used as the striker plate); the push rod could be missing the striker; the raised portion of the timing slide could be missing the push rod; in some changers, a linkage or lever connecting the timing wheel and the push rod could be at fault.

Arm-lifting troubles would be indicated by the tone arm striking or rubbing the records still waiting to be played (arm too high), or by the stylus dragging across the records on the turntable (arm too low)—especially when the stack contains several records. Most changers have an adjustment of some sort, usually at the base of the tone arm; if adjusting can't cure the fault, check to see if the push rod is free, and that the riser plate or striker plate isn't bent. The push rod can be cleaned, if necessary, with the old standby—alcohol. No oil or grease should be used.

Arm Lateral Movement

This operation includes swinging the tone arm from the center, where it has just finished playing a record, outward to the edge of the changer to make room for the next record to drop. Usually, the arm will move outward and hover over the rest post, but will not be set down on the rest unless the last record has been played. Lateral movement also includes the return to a position over the leadin grooves of the record, but we will consider this portion later when we discuss indexing. Both movements are generally actuated by the same portion of the change-cycle wheel or slide, but the action is different.

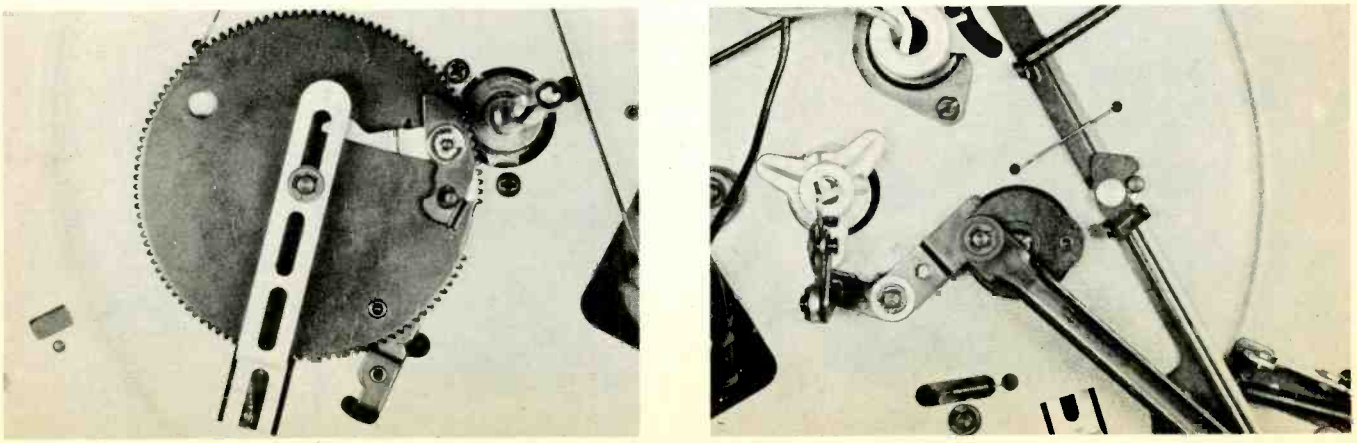

Fig. 9. In these two photos, the above-deck mechanism (left) drives sequential changing operations below decks (right).

To the bottom of each tone-arm spindle is attached a bar. It is fixed firmly to the spindle shaft, usually by a setscrew. Thus, wherever this bar is pushed, the tone arm must follow.

The cycling slide or wheel contacts a linkage or lever (one example is shown in Fig. 11) that in turn applies motion to the lateral-movement bar on the bottom of the tone-arm spindle. As the cycle enters the second phase (moving the arm out of the way), the lateral-movement linkage starts swinging the tone arm outward until its limit is reached, over the arm rest.

Remember that these two movements have taken place during the first few degrees of rotation by the cycling cam.

The most common trouble with this particular portion of the change cycle shows up as the tone arm reaches its outer limit—it doesn't go far enough to clear the record that is about to drop. This can—as often as not—be traced to abuse by the user; the changer has been operated with the tone arm held stationary by hand or by the transporting clamp. In many changers this will cause the arm to be twisted from its normal position on the spindle. Before taking steps to rectify this problem, confirm the cause by checking the setdown position. If it is also wrong, chances are the tone arm has slipped on the spindle. (This may also show up as an inability of the machine to trip automatically. The tone arm reaches the center, but the trip arm below the deck doesn't.) The cure is to loosen the tone-arm setscrew (usually below deck, but not always), run the changer through the first part of its cycle by hand, note where the lateral-motion linkage and bar reach the outer limit, position the tone arm over the arm rest, and tighten the setscrew. This is only an approximate setting, but can usually be refined with the indexing adjustment described later.

Carefully inspect each portion of the linkage and bar; bent parts can usually be spotted quite readily. Straightening may be the only practical cure for some, for they may be riveted in place. Be sure all sections work freely; and keep grease away from these, too.

Record Dropping

The third phase of the change cycle involves dropping the record to the turntable. All modern changers use the center spindle to support the stack of records to be played. Some push the records off the spindle, one at a time, with a tab in the spindle that engages the center hole of the bottom record, while others push them off by a sliding mechanism that contacts the record's edge. In the latter units, the pushoff platform serves also as partial support for the record stack.

Since most changers now use the spindle-dropping method, we will analyze the dropping action of this type first (Fig. 12). There are several different designs, but all operate similarly from the standpoint of practical servicing. The cycling wheel or slide operates a lever that contacts the bottom tip of a push rod which extends up inside the spindle post. As the cycle progresses, the push rod is lifted farther into the post, actuating a small projection, or tab, that extends above the record platform by just about the thickness of a record. Engaging the bottom record, the pushoff tab moves the bottom record sideways until it is no longer supported by the platform; then the record slides down the spindle to the turntable.

Troubles in this dropping system are not at all uncommon. Complaints range from dropping no record through dropping two at a time. Troubleshooting is best accomplished by simply following the sequence of action. The lever which contacts the push rod should be checked to make sure it hasn't become bent. (A few models may incorporate more than one linkage, but the action shouldn't be difficult to trace since you know what to look for.) At the bottom tip of the spindle push rod, you'll sometimes find an adjustment. Make sure this is adjusted so the full action of the lever is transmitted to the push rod, but not so tight that the pushoff tab pushes off two records or can't return to normal. (It must, to engage the next record after one has been dropped.)

Lastly, in the spindle post itself, make sure the pushoff tab isn't binding, and the push rod within the post is free. On some, there is a guide tab that keeps all records except the bottom one centered over the platform portion of the post; make sure this is completely free, and doesn't extend so far down as to interfere with the bottom record.

If any oil or grease has gotten into the post, remove it from the changer deck and flush it out with alcohol. If any of the parts are bent or binding, simply replace the entire spindle post; that's cheaper than trying to repair it, in almost every instance.

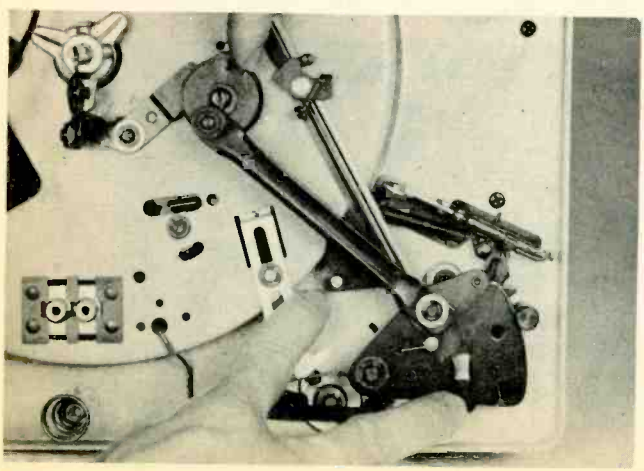

Fig. 11. Cycling wheel (top) actuates lateral movement linkage (under plate at bottom), bar (indicated by index finger).

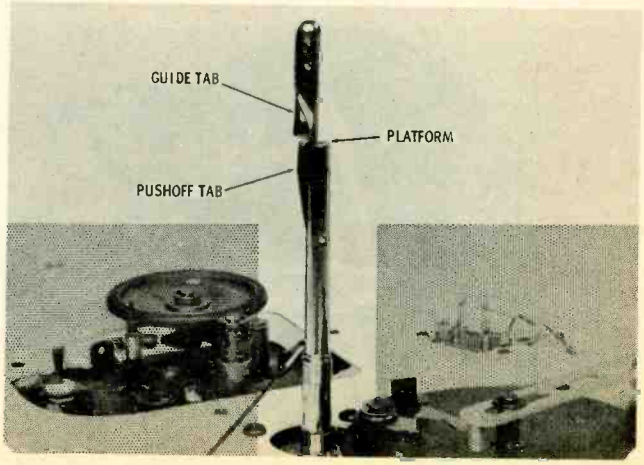

Fig. 12. Spindlepost supports records waiting to be played, and contains mechanism for dropping records one at a time.

The other method of record dropping involves a pushoff platform. In a few older changers, the entire platform moves toward the turntable spindle, pushing the bottom record off the post platform. Modern machines have a flat knife that slides out and pushes the bottom record off the pushoff and spindle platforms. The spindle of these is a fixed post, with no moving parts.

From the standpoint of troubleshooting, this type of system is little different from any other. Trace the motion from the cycling wheel through the linkages to the base of the pushoff platform. Check for free action (with no bends or binds) of the linkage, and of the lever that operates the sliding knife. Occasionally, a knife will become warped or worn and miss a record; recheck the alignment, and replace the knife if you have to. This is one of the few spots that a little lubrication sometimes is needed—*but not grease or oil.* Use a fine grade of powdered graphite, such as you can buy from a locksmith. And use it sparingly; it doesn't take much to do a good job. Just squirt it into the track in which the knife slides, wipe off the excess with a cloth dampened in alcohol, and work the knife back and forth a few times.

Record Size (Indexing)

Since most record-changer users collect more than one record size, changers are usually equipped to "sense" automatically the size of record being played. Some can intermix sizes, but most operate best with one size record at a time. The sensing process, or indexing, is the fourth phase of the change cycle.

Basically, the principle behind most indexing systems lies in designing the machine to operate for 7″ records without any sensing. Indexing for 10″ records is accomplished by placing a sensing tab near the rim of the turntable, projecting through the deck — as in Fig. 13. A 10″ record, extending past the rim of the usual 9″ turntable, blocks any attempted upward movement of the tab. The lack of upward movement is passed on to the indexing mechanism and controls the setdown point for the tone arm.

The 12″ sensing tab most commonly used is also shown in Fig. 13. This tab is struck by the edge of any 12″ record dropping past (on its way to the turntable). It is pivoted within the covering, and when it is struck by the dropping record, it releases a small cam (underneath the deck) that controls the setdown point.

Now let's look at the underside of the deck, and analyze the actual workings of the indexing mechanism. While the arm is pausing over the arm rest, waiting for the record to drop, an indexing plate with three notches (Fig. 14) moves into position around an indexing finger that is part of the lateral-movement bar mentioned in phase two. As the cycling wheel continues its revolution, the lateral movement toward center commences. If neither of the indexing tabs sense a record, the indexing finger enters the deepest of the three notches, and the tone-arm travel is stopped at a position directly over the leadin grooves of a 7″ record.

However, if the tab adjacent to the turntable can't rise (because a 10″ record has dropped), the indexing plate is held in such a position that the finger engages the middle slot; the tone arm then moves only as far as the 10″ setdown position. If a 12″ record trips the 12″-sensing tab, the small cam moves into position and blocks the arm movement at a point over the 12″ leadin grooves.

Another system, used in some more elaborate changers, uses a feeler arm that swings out and contacts the edge of the records still on the center post. Underneath, the second phase of the cycling action also swings a serrated or notched plate past the below-deck portion of this feeler arm; wherever the feeler is stopped by striking the record edge, the appropriate notch is engaged. Then the record drops (phase three), and the cycling action swings on into the indexing phase. The notched plate stops the inward lateral movement of the tone arm at the correct setdown point.

Troubleshooting the indexing system of any changer is simply a matter of tracing the sequence of actions, making sure that each operation has the desired effect on limiting the return travel of the tone arm. If the normal speed is too fast to permit convenient observation, spin the turntable by hand, and trip the appropriate indexing sensor at the point in the cycle when the record would normally drop (watch the pushoff tab or knife).

The most common complaint is that the tone arm misses the record or is set down too far into the record. All except the most inexpensive changers have an adjustment at the base of the tone arm that will make compensation for any slight indexing error. If the error is beyond the range of adjustment, it may be neces-

Fig. 13. Indexing sensors for both 10″ and 12″ record sizes.

Fig. 14. Plate with notches controls setdown position of arm.

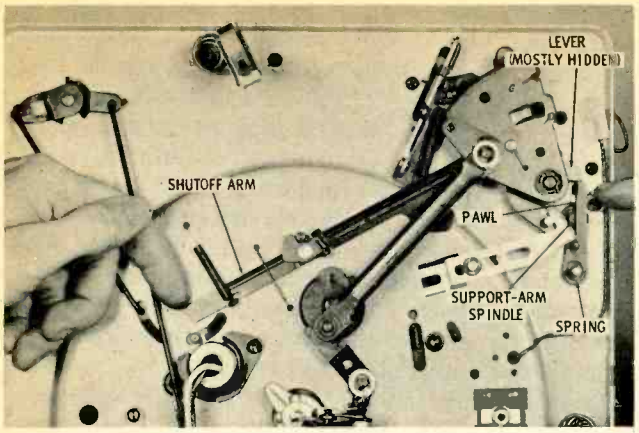

Fig. 15. Component parts of automatic shutoff mechanism.

sary to loosen the tone-arm setscrew (described earlier) and slightly change the position of the tone arm on its spindle.

In case this latter step is necessary, be sure to check the lateral travel as described under the paragraphs on "lateral movement"; if the arm gets in the way of dropping records, or doesn't trip correctly, the indexing system is at fault and must be repaired. The only part likely to bend is the indexing finger, and this is ordinarily not difficult to replace. Other parts should be kept clean and free of oil and dirt, as with most other sections of the changer mechanism.

Arm Setdown

When the arm is indexed into position, it is then lowered vertically to the record—phase five of the change cycle. This action is accomplished by the same parts that lift the arm. If the push rod (and levers, if used) are free, little trouble should be encountered.

Occasionally, the arm will be sluggish about lowering to the record. If so, check the pivot screws on the tone arm; sometimes they are too tight, or become gummy, and cause the arm to remain above the record. Make sure the arm can raise and lower freely, needing only its own weight to pull it downward.

Resetting

The five phases of the change cycle are accomplished in one revolution of the cycling wheel or cam. The wheel then returns to a resting position, awaiting the next tripping impulse. In some changers, a positive detent prevents movement beyond this resting point unless the tripping mechanism functions. In most, this step is accomplished by merely disengaging the drive, usually by a few missing teeth on the drive gear or an indentation in a rubber cycling cam. The next trip action again engages the drive.

In some machines, the trip pawls are on the cycling cam. In others, they are mounted on the deck. In either case, at some point in the cycle they are pushed back to their initial position in readiness for the next velocity tripping action. Make sure the trip pawl is repositioned; otherwise, constant tripping (recycling) will occur.

Loose and sloppy drive gears or cycling cams will also cause recycling. Any parts with defective teeth (or rubber tire) should be replaced without question, as should any that become worn and loose on the mounting shaft. And the ever-constant warning—keep oil, grease, and dirt *out*.

Automatic Shutoff

Automatic shutoff indicates one of two common operations—either complete shutoff (removing power from the motor) or merely bringing the tone arm to rest on the armrest. In the latter case, the motor continues to operate until shut off manually. A few that completely shut off also remove the drive idler from contact with the driving shaft, to prevent the "bumps" described earlier.

The sensing device that indicates when no more records are waiting to be played is usually the record-support arm that keeps the records flat on top of the spindle post. When resting on records, the support arm is partially up out of its pivot post; after the last record is dropped, the support arm drops back all the way and contacts the shutoff linkage. Actuating the shutoff linkage alters the last two phases of the change cycle—the indexing and setdown—and sets in motion the switch-shutoff device, if one is used.

In changers that use the feeler arm for indexing, shutoff is usually initiated by the feeler when it fails to detect any more records on the centerpost. A few older changers sensed the shutoff with the center spindle; the weight of records unplayed kept the shutoff disabled until the last record had dropped.

The last two phases of the change cycle are altered very slightly. The indexing step merely changes so the tone arm is blocked completely from moving laterally toward the centerpost; instead the arm hovers over its rest until the fifth phase sets it down on the rest. Remember that this change in indexing is brought about by the shutoff *sensor*.

The support arm, while resting on top of one or more records, has no effect on the shutoff pawl—see Fig. 15. The spring holds it in the position shown, where it blocks the shutoff lever and prevents any movement of the shutoff arm. When the final record drops, the support arm sinks to its lowest position; its pivot shaft projects from the bottom of the deck and pushes the pawl out of the way of the shutoff lever. Then, when the record is finished, as the tone arm moves outward (phase two of the change cycle), a portion of the positioning bar on the bottom of the tone-arm shaft moves the shutoff lever and bar into position beside the switch lever, because the pawl is not in the way to interfere. The final set-down movement (phase five) pushes the lever and bar, which in turn pushes the switch to the off position.

Other shutoff mechanisms can be traced in the same manner, merely by observing the effects of the sensor on the levers and bars that actually shut the switch off.

Conclusion

Fixing record changers by guess-and-try is a difficult, complicated task; it's no wonder servicemen shy away from such a job. But with a planned, ordered approach such as outlined here, a mechanical problem can be solved as easily as an electronic one. The key is in the logical, step-by-step analysis of the several separate actions—and now that key is yours. ▲

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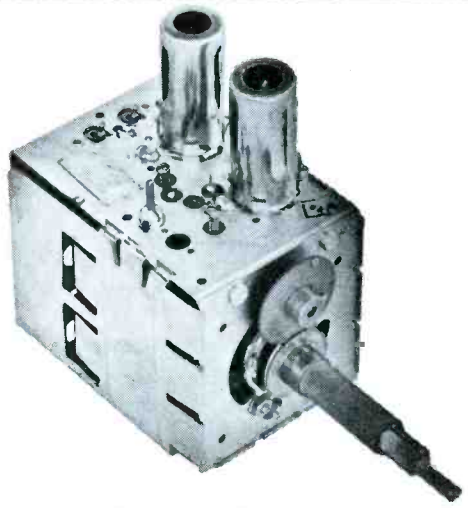

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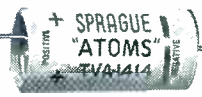

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PF REPORTER

including Electronic Servicing

VOLUME 13, No. 8 **CONTENTS** AUGUST, 1963

ABOUT THE COVER

Here's the rub for many servicemen when they attempt to repair phonographs and tape recorders: they have trouble figuring out how these units should normally function. This special issue addresses itself to the task of making phono and tape devices more understandable, hence easier to service.

LETTERS TO THE EDITOR

Dear Editor:

I had practically forgotten about the PF REPORTER Ten-Year Subject Index January, 1961 issue). Recently, however, I had need to locate a Troubleshooter item concerning picture pulling in a certain TV chassis. I remembered the item was published several years ago, but couldn't recall just which issue. As I started to thumb through past issues, I came across the Ten-Year Index. Needless to say, in a couple of minutes I had located the information I wanted—in the April, 1958 issue. Just had to say "thanks" for the Index; I think I'll frame it.

HAROLD S. VANDEMAN
San Bernardino, Calif.

Never thought I'd be so willing to agree to an obvious "frame-up." Incidentally, reprints of the "Ten-Year Cumulative Subject Index 1951-1960" are still available at no charge.—Ed.

Dear Editor:

In the article "Molecular Electronics Explained" in your May issue, reference was made to our product *Nichrome* without mention of the fact that its name is a registered trademark of the Driver-Harris Company. *Nichrome* is a very old trademark, having been registered by us in 1908 and used continuously ever since that time to denote our famous alloy.

R. B. ALLARDICE, JR.
Secretary-Treasurer
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We certainly had no intention of breaking a precedent of over 50 years' standing!—Ed.

Dear Editor:

Enclosed is a sample of a splice for 300-ohm twin lead. We think this is a better method than the one shown on page 41 of your April, 1963 issue.

STUART WELWOOD
The Village Radio & TV Shop
New Milford, Conn.

Dear Editor:

We are using a twin-lead splice that we believe to be better than the one illustrated in "How to Strip and Solder Cables" (April issue) If you stagger the cuts in the two leads, and overlap the stubs of plastic insulation between the spliced lead ends, you will find you have a pretty sturdy connection after it is secured with a good plastic tape. Wind the tape from bottom to top on a vertically mounted outdoor lead, to make it more weatherproof.

HENRY TYSSE
Holland Radio & Appliance Co.
Holland, Mich.

Dear Editor:

I was really surprised to see the illustration for splicing 300-ohm twin lead in your April issue. No wonder you say this lead should not be spliced if it can be avoided. I'm sending you a splice of a type I use all the time, and think you will agree with me that it is far superior to the one you illustrate. You'll note I do not cut away the center of the insulation, but overlap the ends and use them as reinforcements.

R. J. STONER
Aurora, Colo.

Dear Editor:

We formerly used the splicing procedure shown in your April issue, but found it had a tendency to break and cause a lot of trouble. Enclosed is a sample of a splice that works ten times better.

GABRIEL BOURDON
Lachute, P. Q.
Canada

Dear Editor:

Why didn't you show the boys a splice that is a splice? I am enclosing a sample of one that is stronger than the rest of the line, once it has been taped.

M. W. THOMPSON
Toronto, S. Dak.

Dear Editor:

On splicing 300-ohm lead-in, I always leave about a 1" tab of plastic insulation on each piece; this makes a better strain joint.

ARNOLD J. BURT
Grand Rapids, Minn.

Dear Editor:

The splice shown is okay for an "inside job," but outdoors it is a weak sister. Instead of cutting off the stub ends of insulation, you can overlap them and tape them together to reinforce the splice. I have used this method for many years, and have yet to see one fail. Personally, I prefer to leave the soldered wire ends untaped, and coat them with plastic spray to weatherproof the joint. Tape over the rough surface of the wires tends to form a moisture trap that invites trouble.

WALTER G. DUNBAR
Normal, Ill.

We connected all your sample splices end to end (using the suggested method, of course) and used them to hang the author of the article.—Ed.

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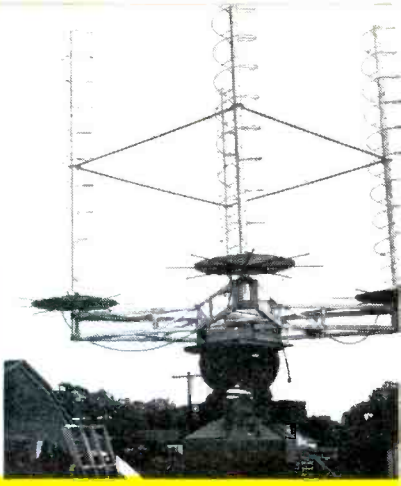

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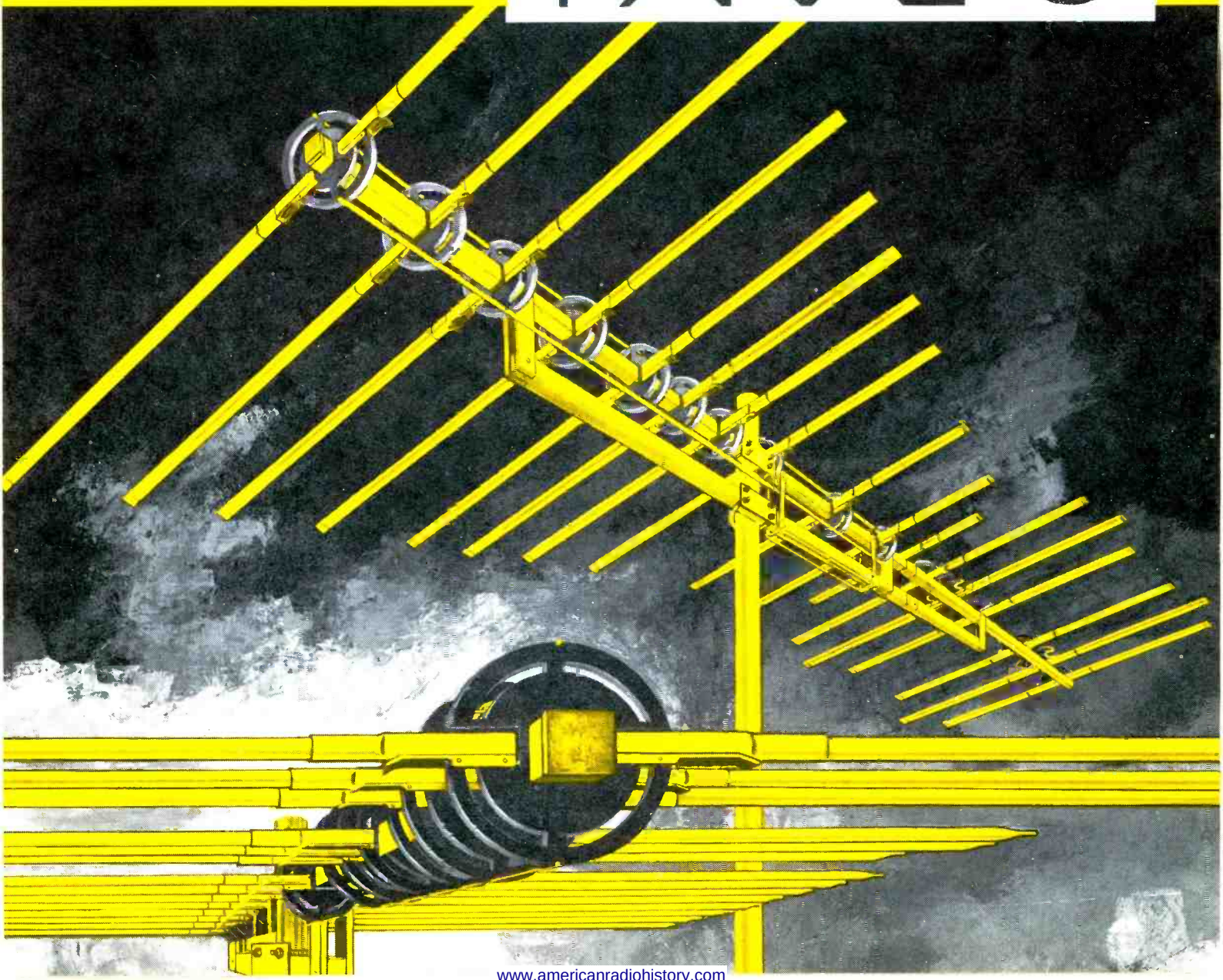

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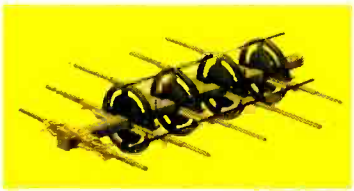

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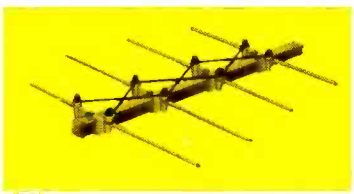

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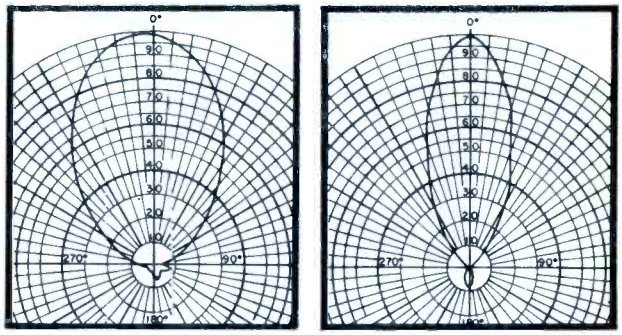

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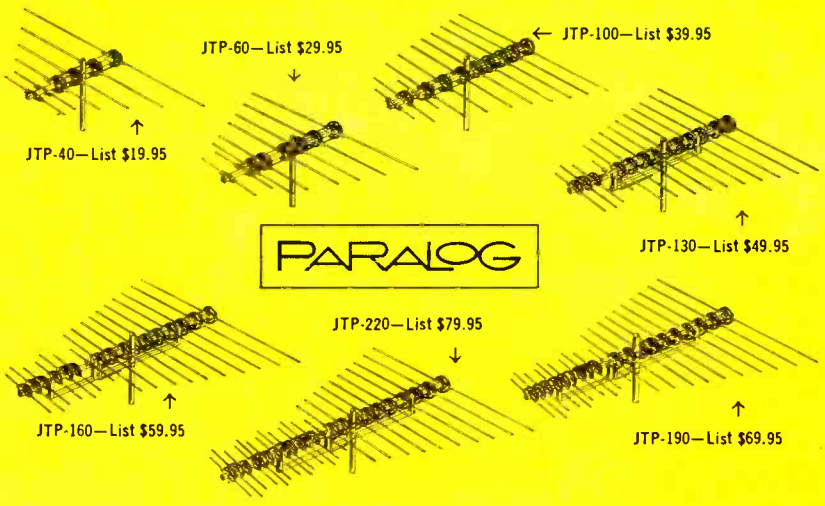


SENCORE
SIMPLIFIES COLOR SERVICING

NEW! CA122
COLOR CIRCUIT ANALYZER

A simple approach to a complex problem

Here is an instrument that is designed to eliminate the guesswork in color TV servicing. A complete analyzer that provides all required test patterns and signals for testing from the tuner to the tri-color tube. Additional analyzing signals for injection at each stage including audio, video and sync, brings to life a truly portable and practical TV analyzer for on the spot service; virtually obsoleting other analyzers with the advent of color. Sencore's simplified approach requires no knowledge of I, Q, R-Y, B-Y, G-Y or other hard to remember formulas. The CA122 generates every signal normally received from the TV station plus convergence and color test patterns.

The CA122 offers more for less money:

TEN STANDARD COLOR BARS: The type and phase that is fast becoming the standard of the industry. Crystal controlled keyed bars, (RCA type) as explained in most service literature, offer a complete gamut of colors for every color circuit test.

WHITE DOTS: New stabilized dots, a must for convergence, are created by new Sencore counting circuits.

CROSS HATCH PATTERN: A basic requirement for fast CRT convergence.

VERTICAL AND HORIZONTAL BARS: An added feature to speed up convergence, not found on many other color generators.

SHADING BARS: Determines the ability of the video amplifier to produce shades (Y Signal) and to make color temperature adjustments. An important feature missing on other generators.

COLOR GUN INTERRUPTOR: For fast purity and convergence checks without upsetting color controls. Insures proper operation of tri-color guns, preventing wasted time in trouble shooting circuits when CRT is at fault.

A must for color . . .

a money maker for black and white TV servicing

ANALYZING SIGNALS: RF and IF signals modulated with any of the above patterns for injection into grid circuits from antenna to detector. IF attenuator is pre-set for minimum signal for each IF stage to produce pattern on CRT thus providing a check on individual stage gain. Sync and video, plus or minus from 0 to 30 volts peak to peak, have separate peak to peak calibrated controls for quick checks on all video and sync circuits. Crystal controlled 4.5 mc and 900 cycles audio simplify trouble shooting of audio circuits.

NEW ILLUMINATED PATTERN INDICATOR: A Sencore first, offering a rotating color film that exhibits the actual color patterns as they appear on color TV receivers. Locks in with pattern selector control.

You'll pay more for other color generators only.

Dealer Net **187.50**

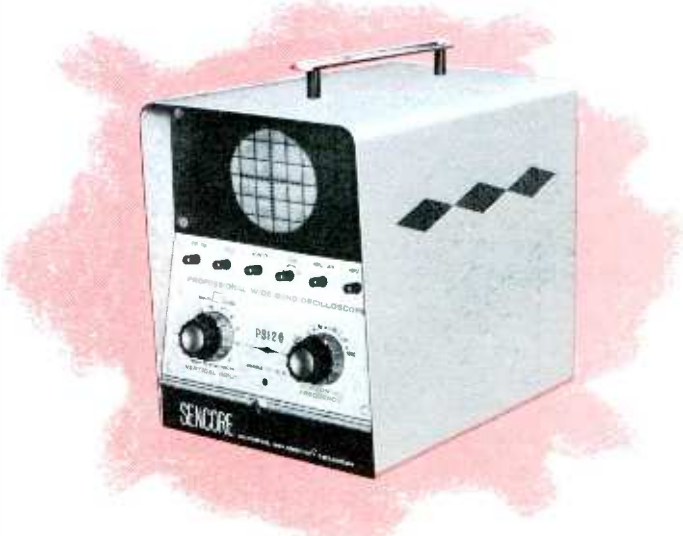
NEW! PS120 PROFESSIONAL WIDE BAND OSCILLOSCOPE

A portable wide band 3 inch oscilloscope for fast, on-the-spot testing. An all new simplified design brings new meaning to the word portability... it's as easy to operate and carry as a VTVM. Though compact in size, the PS120 is powerful in performance: Vertical amplifier frequency response of 4 MC flat, only 3 DB down at 7.5 MC and usable to 12 MC, equips the technician for every color servicing job and the engineer with a scope for field and production line testing. AC coupled, with a low frequency response of 20 cycles insure accurate low frequency measurements without vertical bounce. Sensitive single band vertical amplifier; sensitivity of .035 volts RMS for one inch deflection saves band switching and guessing. Horizontal sweep frequency range of 15 cycles to 150 KC and sync range from 15 cycles to 8 MC (usable to 12 MC) results in positive "locking" on all signals. New exclusive Sencore features are direct reading peak-to-peak volts —no interpretation; dual controls to simplify tuning; lead compartment to conceal test leads, jacks and seldom used switches. Rear tilt adjustment angles scope "just right" for easy viewing on bench or production line.

Size: 7"w x 9"h x 11¼"d. Weight: 12 lbs.

Dealer Net **124.50**
(with low cap. probe)

Kit **74.50**



A must for servicing color TV in the home . . . lowest priced broad band scope. All hand wired — all American made

SENCORE

SIMPLIFIES SWEEP CIRCUIT TROUBLE SHOOTING

SS117
SWEEP CIRCUIT ANALYZER

For Color and Monochrome Testing

A professional trouble shooter that helps you methodically walk the trouble out of "tough-dog" sweep circuits in monochrome and color receivers. The SS117 provides a positive but simple push button test on all circuits indicated in the block diagrams. These time-consuming circuits are checked step-by-step with tried and proven signal injection and substitution methods. All checks can be made from the top of the chassis or from under the chassis when it is removed from the cabinet.

TV horizontal oscillator check is made by substituting a universal oscillator known to be good. Horizontal output check consists of a cathode current and screen voltage test. The TV horizontal yoke is checked by substituting a universal yoke from the SS117 and viewing brightness or restoration of 2nd anode voltage. Horizontal flyback is checked dynamically in circuit by measuring the power transfer to the yoke when TV is turned on. TV horizontal sync can be used to control the SS117 horizontal oscillator, providing a positive check on sync from the video amplifier to the TV oscillator. Vertical circuits are tested by simple signal injection from vertical yoke to oscillator for full height on CRT. The SS117 with the CA122 Color Analyzer provides a complete TV analyzer for virtually every stage in monochrome or color receivers.

External checks for AC, DC, peak to peak voltage readings and DC current in the upper right hand corner save using a separate VTVM. Accurate 2nd anode measurements up to 30,000 volts are made with a sensitive 300 microamp meter and the attached high voltage probe. AC outlets, all steel construction and mirror in the cover makes every servicing job easier.

Size: 10¼" x 9¼" x 3½". Wt. 10 lbs.

Dealer Net **89.50**

The SS117 checks them all

FREE—A 33 RPM half hour permanent record packed with every unit explains each test.

FOR FASTER MORE ACCURATE TUBE TESTING

TC114 MIGHTY MITE
TUBE CHECKER

This is the famous Mighty Mite, acclaimed by over 25,000 servicemen, maintenance men and engineers as "the best they've ever used." A complete tube tester that is smaller than a portable typewriter yet finds tubes that testers costing hundreds of dollars miss, thus selling more tubes and reducing call backs. A real money maker for the serviceman and a trusty companion for engineers, maintenance men and experimenters. The Mighty Mite has been acclaimed from coast to coast as the real answer for the man on the go. Even though the Mighty Mite weighs less than 8 pounds, new circuitry by Sencore enables you to use a meter to check grid leakage as high as 100 megohms and gas conditions that cause as little as one half microamp of grid current to flow. Thus, too, it checks for cathode current at operating levels and shorts or leakage up to 120,000 ohms between all elements. And it does all this by merely setting four controls labeled A, B, C, & D with new type easy grip knobs. Check these plus Sencore features... Meter glows in dark for easy reading behind TV set... The new Mighty Mite has large size Speedy-Setup Tube Chart inside of cover—cuts setup time for even faster servicing. New stick proof D' Arsonval meter will not burn out even with shorted tube... Rugged, all steel carrying case and easy grip handle.

The improved Mighty Mite will test virtually every radio and TV tube that you encounter, nearly 2000 in all, including foreign, five star, auto radio tubes plus the new Compactrons, Novars, Nuvistors and 10 pin tubes. Has larger, easy-to-read type set-up booklet for faster testing.

Size: 10¼" x 9¼" x 3½". Weight: 8 lbs.

Dealer Net **74.50**

Fast, Accurate . . . never lets you down

A must for color

TM116 TUBE TESTER MODERNIZING PANEL

New tube adapter for testing Compactrons, Novars, Nuvistors and 10 pin tubes in any tube tester except cardomatic types. Plugs into octal socket of your tube tester enabling you to test these new tubes in the same manner that your tester checks conventional tubes. Tube set-up chart included with each adapter.

Dealer Net **24.95**

The Electronic Scanner

Fuse News

Littelfuse, Inc. has developed a new transparent plastic top for the standard metal boxes used for packaging its line of electronic, electrical, and automotive fuses. Like the metal lid formerly used, the new top slides open. Walter Clements, Littelfuse vice president, states that not only will this new way of merchandising stimulate fuse sales through visible exposure of the product, but it will cut down inventory time considerably.

Littelfuse conceived their "see-through" container some time ago, and instituted a marketing survey in the field. Since the prime reason for a "see-through" plastic box is to allow a user to see the fuses instantly, Littelfuse customers unanimously suggested a transparent lid. "The natural tendency is to place the box on the table with the right side up," commented one of the firm's leading customers.

Sweepstakes Off and Running!

The first of the 1963 series of **Amperex** Sweepstakes contests for service technicians wound up with an announcement of 10 grand-prize winners—each receiving a Motorola console TV. 100 consolation-prize winners each received a Sessions electric clock.

The contest calls upon the entrant to identify — from a photograph — a widely used TV chassis, supplying the manufacturer's name and the chassis number. A different chassis is represented in each of the four 1963 contests. Entry cards, rules, and full-color illustrations are on display at Amperex distributors.

Two-Way Contract Awarded

Mr. G. E. Smith, president of **Communications Co., Inc.,** announced a contract with DuMont Laboratories of Clifton, New Jersey, by which Comco will provide DuMont's Communications Dept. with a complete line of VHF and UHF land-mobile FM communications equipment. The new contract will provide for mobile, base, and remote-control units to operate in the 25-50 mc, 150 mc, and 450 mc bands. Transistorized equipment in the 150 mc range, presently in production at Comco, is included in the contract. Delivery time to Comco dealers will not be affected by the new contract, because of a factory expansion program completed last year.

Planning Technirama '64

Philco Corp. is planning two new Technirama programs in 1964, covering both appliances and electronics. R. E. Nugent, manager of the Parts and Service department, said the success of Technirama '63, which attracted more than 20,000 service personnel to a series of 123 scheduled meetings, prompted Philco to plan the new series.

Technirama '63 covered the servicing of Philco's "Perma-Circuit" panels and "Cool Chassis" television receivers, color television, and multiplex FM.

Philco International Corp. will sponsor a Technirama this summer for Latin-American technicians in Kingston, Jamaica. These meetings will cover the servicing of "Perma-Circuits," transistor theory, and some basic FM and multiplex circuits.

New Plant Site

A new ten-acre plant site located in the Chatsworth, Calif. industrial area has been purchased by **Clear Beam Antenna Corp.,** according to Bob Raynor, President of the firm. Clear Beam's expansion plans are necessitated by increased sales and continued growth of its product line in the United States and overseas markets, plus the addition of new products developed by its newly formed Chatsworth Industries Division.

Currently occupying a space of 64,000 square feet at a plant in Canoga Park, California, the company produces over 8,000 antennas per day, utilizing the most automated production equipment in the industry. On the new site, Clear Beam plans to build larger production quarters of more than 100,000 square feet to accommodate increased product research and development.

*SUGGESTED RETAIL PRICE

What's extra?

Extras on the VW Truck that you don't pay extra for:

1. Bumper guards.
2. Bumper overriders.
3. Outside rearview mirror.
4. Fresh air heater/defroster.
5. Fresh air ventilating system.
6. Passenger seat.
7. Cabin partition.
8. Cabin-width parcel shelf.
9. Synchromesh 4-speed transmission.
10. Directional lights.
11. I.C.C. safety lights.
12. Dome light.
13. Tool kit.

Extras on the VW Truck that you pay for:

1. Swivel driver's seat $70.90.*
2. Additional set of side doors for the left side $80.00.*
3. Outside right-hand mirror $6.95.*
4. Windshield washer $12.15.*
5. Walk-through front seat with split partition $59.80.*

The point is this: If you want custom extras on your truck, we have them. (At reasonable prices.)

But why pay extra for stuff that's standard equipment on a Volkswagen?

Dick Nyholm, Radio & TV, 108 N. Lower Ave., Centralia, Washington

"Television antennas represent an important part of my business. Since handling Winegard Colortrons, my business has increased greatly. Seems that one person tells another and your advertising also pays off."

Edwin L. Fisher, Fisher Appliances, Inc., 107 N. E. Front Street, Milford, Delaware

"During the thirty-one years I have been in the Radio and Appliance business few new items have been so immediately successful as your Colortron antenna.

"Our sales of color television testify that your new Colortron antenna has been the answer. In fact we will not sell a customer if they are not willing to install a proper type antenna to operate the new color set.

"Hoping this letter will encourage you to further efforts in developing more new products."

Ken Kesler, Electromatic, Inc., 237 N. E. Broadway, Portland 12, Oregon

"We have used the Winegard assortment of antennas for over three years and find that whatever situation we encounter, Winegard has the answer.

"We have been especially pleased with the WINEGARD COLORTRON which we have used extensively since Color TV has come into its own."

Ray Summers, Ray Summers, Inc., Louisville, Illinois

"We live in an area which has the poorest television reception in the State of Illinois. There are no stations closer than 100 miles. Our TV and antenna sales have more than doubled since using the Winegard Colortron as it has improved reception to the point where we can get good reception from several channels."

George W. Terry, Terry's Electric, McLean, Texas

"I am so pleased with the new Winegard Colortron antennas that I would like to tell you about the reception we have here in McLean, Texas.

"We have these antennas as far as 100 miles from our local stations in Amarillo, Texas and the customers are overjoyed with the reception.

"We have installed over 200 Winegard Powertrons and Colortrons on a money back guarantee. As yet we haven't had the return of even one antenna!"

Twin City Radio & TV, Inc., 97 National Avenue, Chehalis, Washington

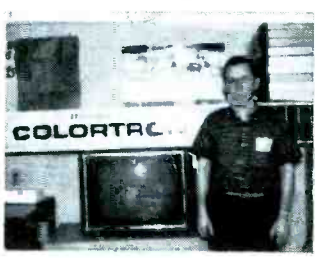
"We are especially pleased with Winegard Colortrons and the Nuvistor amplifier is the best by far. Keep up the great engineering and your fine advertising-both help us sell more antennas and boosters."

THEY SAY IT BETTER THAN

Some of America's leading dealers tell why they think Winegard Colortrons are

Dave Tucker, Avon Television Co., 189 Bway, Amityville, New York

"We here at Avon T.V. have used many different antennas for our color installations and have found that for best all around results in color as well as black and white reception the Winegard Colortron is superior in every respect."



William D. Miles, Miles Electronic Co., Baxley, Georgia

"We are over one hundred miles from the nearest commercial station. We have tried most of the so-called color antennas. Thanks to Winegard's high signal-to-noise ratio and high directivity Winegard is the only acceptable antenna-booster combination which was found to meet our 'customer's satisfaction' requirements. Beautiful color is being received now with the Colortron."

Roy Sahlin, Central Television & Appliance, 911 Chehalis Ave., Chehalis, Washington

"Finest piece of equipment we have worked with in electronic field. The Winegard Colortron and all Winegard products have no competition."

Walter Finkbeiner, 107 New Jersey Ave., Absecon, New Jersey

"I have found the Winegard Colortron and Electronic Power Pack to be the most powerful antenna in our fringe area. Colortron antennas make a perfect combination with our Admiral Color television installations.

"I install Colortrons on trial and have not lost a sale to date."

Charles Dumaine, Dumaine Antenna Service, 735 Woodtick Road, Waterbury, Conn.

"Among the top three antennas I have found it to be the best for any reception. The AP220N Nuvistor Amplifier is tremendous in controlling both high and low channels; eliminating all types of interference. Being an exclusive Winegard dealer, I make between 30 to 40 installations per week of the Winegard Colortron and Amplifier. The people for whom the installations were made are all well satisfied with the performance; bringing more business my way than I can handle."

Leonard P. Hellenthal, Nielsen & Neilson, Inc., 1462 Glendale Blvd., Los Angeles 26, California

"I am extremely happy to inform you that we have been a constant user of the Winegard line of antennas and related products for six or seven years.

"We are now moving into the Colortron series which we find to be another added improvement in new type hardware and improved over-all performance.

"As you know, our clients in this area consist of many television and movie stars as well as prominent city officials. We are, therefore, of necessity, quite concerned about the equipment we use and its performance. We are looking forward to future success with this newer series of antennas and amplifiers."

J. C. McNiven, The Gester-McNiven Co., 305 N. Tower, Centralia, Washington

"We feature Winegard Colortrons because they have helped us immeasurably to sell more color sets. They really bring in a magnificent color picture and black and white is also the best. Finest antenna on the market, and we've tried them all."

G. Borders, Borders Radio & TV Service, Flora, Illinois

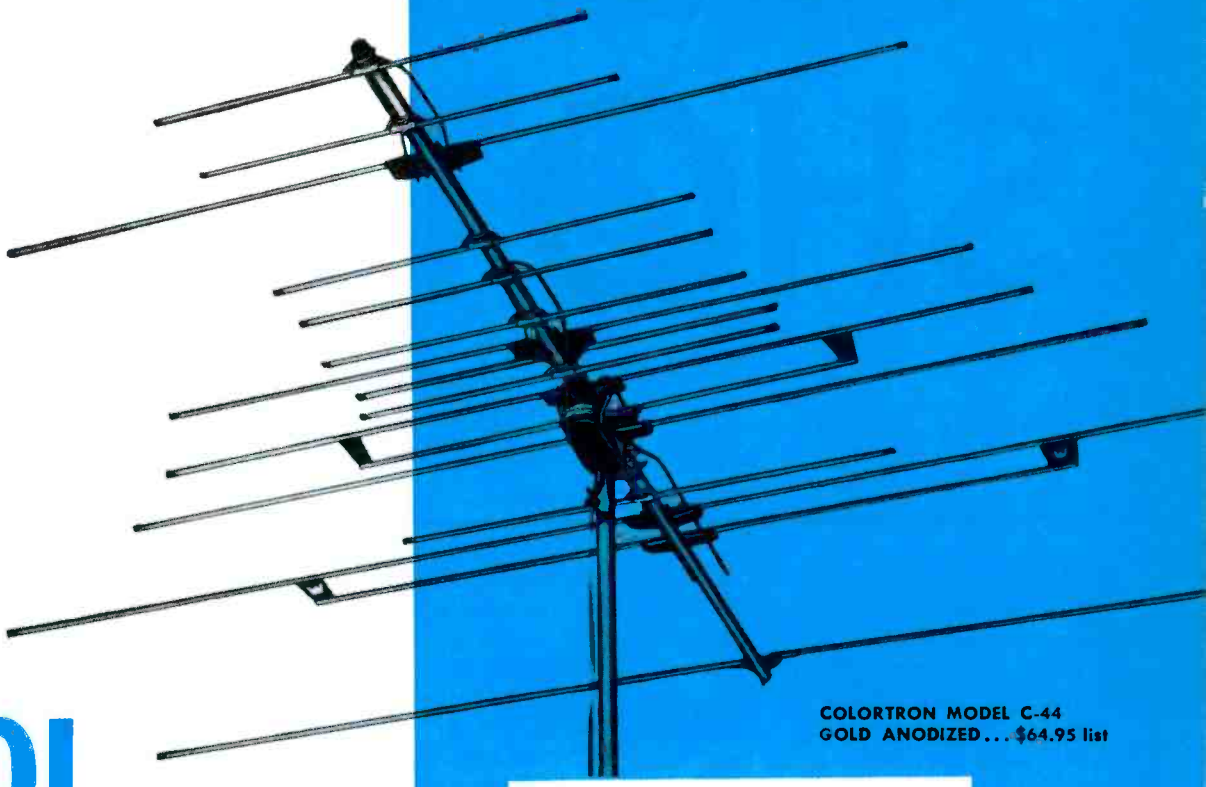
"In my opinion, the Winegard Electronic Antenna is perhaps the finest piece of equipment I have worked with in the last thirty years."

J. A. Etchison, Etchison Brothers Appliances, Flora, Illinois

"The new Winegard Colortron with the twin nuvistor amplifier permits us to give our customers the best television reception ever!"

Berkeley M. Phelps, TV & Radio Repair, Washington Depot, Conn.

"The high gain of Winegard antennas and boosters give the customer excellent pictures on channels that were not usable before. Winegard equipment does not require sales pressure —seeing is believing!"



COLORTRON MODEL C-44
GOLD ANODIZED... $64.95 list

WE DO!

the world's finest TV antennas...

Jack Ross, Smith's Home Furnishings, Portland 2, Oregon

"This is hilly country, with lots of tall trees. We install and service thousands of sets a year. We've found many real problem areas—where only a Winegard Colortron antenna with Nuvistor amplifier will pull in the kind of picture a set owner has the right to expect. We recommend Colortron to our customers — especially to the many people now buying Color TV."

David B. Newman, Radio Service Co., 262 Ninth St., Astoria, Oregon

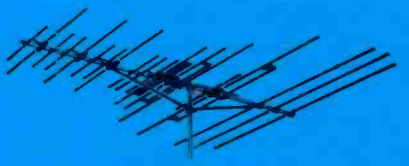
"With the new Colortron TV antenna and Stereotron FM antenna and matching Nuvistor boosters we have obtained excellent reception of the Portland, Oregon TV and FM stations. We are 100 miles from Portland with the coast range of hills between us. We also obtain good results from Seattle, 150 miles away. These are the finest antennas on the market today!"

If you haven't tried Winegard Colortron antennas or Colortron Nuvistor amplifiers, we hope you will try a few soon.

We feel confident there is nothing on the market that can match them for performance and quality. Write for technical bulletins or ask your Winegard distributor.

Takes up to 400,000 Microvolts input—
Model AP-200N
$39.95 list

COLORTRON
Twin Nuvistor
AMPLIFIER



MODEL C-43 $51.90 list

MODEL C-42 $34.95 list

MODEL C-41 $24.95 list

Winegard
ANTENNA SYSTEMS
3009-8 KIRKWOOD • BURLINGTON, IOWA

IS THE CARTRIDGE SHOT?

by
George F. Corne, Jr.

What to do about "front-end" troubles in phonos.

Although small in size, the phono pickup cartridge has a crucially important function in an audio reproducing system. No matter how elaborate the amplifier and speaker system may be, the net result and quality of the output can be only as good as the information transferred from the pickup.

Let's take a closer look at the ceramic and crystal cartridges being used in most home entertainment equipment (excluding the more elaborate and expensive types of high-fidelity components). We'll focus on the physical construction of these pickups, the main factor in their performance; then we'll discuss their most vital part, the needle.

Physical Structure

A few slabs of ceramic material, an elastic torque coupler, three or four connecting terminals, and two different-sized needle tips: Combine these inside a mounting assembly, and you have a basic phono cartridge. Fig. 1 shows the internal construction of a typical stereo unit. Two ceramic slabs (of barium titanate) are used for each channel. The slabs in each pair are clamped together, with an insulating strip between them, and both pairs are mounted to a rigid support at the rear of the assembly. At the front, all of the slabs are attached to a flexible torque coupler that has a V-shaped slot in which the stylus rests. As the needle moves through the grooves of the record, its movement is passed through the stylus to the coupler—which in turn warps or bends the ceramic slabs, generating a corresponding audio voltage.

The rubber damper marked in the photo is placed between the ceramic elements to prevent excessive bending or shaking of the ceramic slabs. This feature helps to smooth out the frequency response of the cartridge.

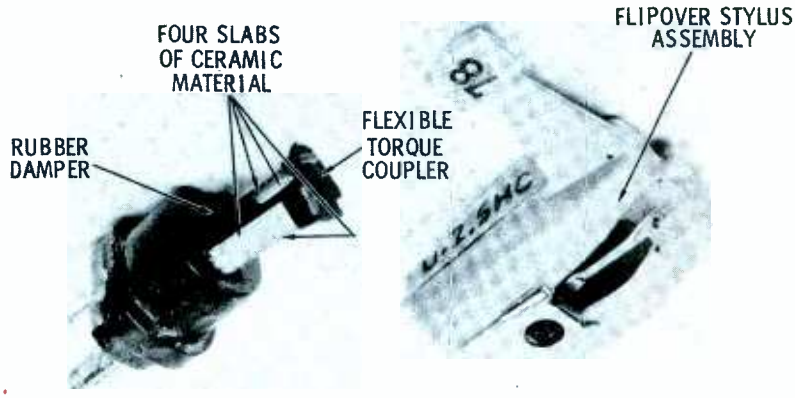


Fig. 1. The torque coupler transfers force from stylus to ceramic slabs.

Fig. 2 is a rear view of this same cartridge. The four terminals protruding from the rear provide connections from the cartridge to the amplifier input circuit. Slip-on connectors are generally used at this point instead of soldered terminals, since heat is very damaging to a cartridge. If a wire or terminal connector happens to break, disconnect the lead *before* repairing it.

Cartridge Failure

Despite the small size of cartridges, they are still fairly rugged components. Usually, the cause of failure is simply physical deterioration of the different materials in the cartridge. Take the torque coupler, for instance: The consistency of its elastic material must be rigid enough to transmit the stylus motion to the ceramic slabs; however, it must still be flexible enough to prevent jarring of the stylus assembly. With age, this material may become hardened, and lose some of its ability to reproduce the vibrations recorded in the grooves of the record. For a similar reason, the sound output can become distorted due to a hardening of the rubber damping device in the cartridge. The length of time a cartridge can be used before failures of this type occur will depend, of course, on the operating conditions and the unit's construction.

Physical shock, more than any other cause, shortens the life of cartridges. The average customer, usually because he doesn't realize the harm he's doing, fails to treat the unit with *tender care*. He accidentally drops the tone arm, or jars the cartridge in some other manner . . . kids are especially good at this! Some newly introduced cartridges have a "floating" mechanism to prevent possible damage to both the cartridge and the needle. Anytime pressure is applied to the cartridge, it retracts safely into the tone arm, and a "bumper" (located on the tone arm) absorbs the shock. There are several different versions of this type of design—floating cartridge or flexible needle—presently available; the future will probably bring other similar designs.

How can a serviceman spot a

• *Please turn to page 75*

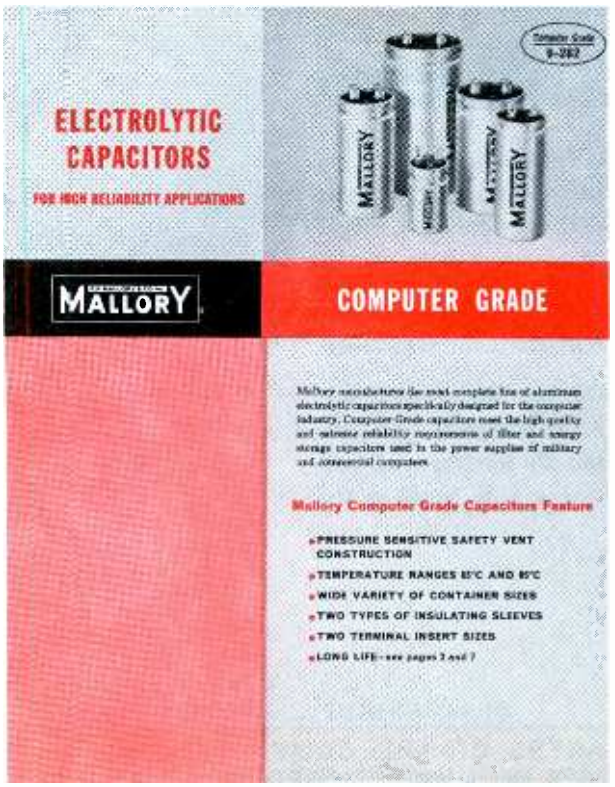
P. R. MALLORY & CO. Inc.

MALLORY

Tips for Technicians

Mallory Distributor Products Company
P.O. Box 1558, Indianapolis 6, Indiana
a division of P. R. Mallory & Co. Inc.

When you need a lot of microfarads...



Ask your Mallory Distributor for Bulletin 9-282 on Computer Grade Capacitors. It lists all ratings which he carries in stock.

You may be occasionally confronted with the problem of finding a lot of capacitance. Maybe for a sound system where you want to squeeze the last bit of ripple out of a power supply. Or for brute-force filtering of low voltage, as in a DC supply for filament circuits.

If your first inclination is to round up a bunch of duals, triples and quads until they add up to the microfarads you need, then hook them in parallel—for the sake of your budget, resist the temptation and read the rest of our tip. For you can get a lot of capacitance in a single unit, at considerably lower cost, by using a Mallory Type CG Computer Grade Capacitor.

These are called computer grade because they were designed specifically for use in computer power supplies. But you don't need to own a computer to use them. What's special about them is the way they're made. Since they are expected to last practically forever, they are made of extra-pure materials and assembled with tender, loving care. All of which seems to pay off, for they turn out to be just about the purest microfarads you can find—very low in equivalent series resistance and d-c leakage. And life is almost unbelievable! We've tested them for the equivalent of *20 years* service at room temperature!

What *isn't* special about them is their price. In many instances, a single Type CG will cost less than half as much as the three or four conventional capacitors you would need to get the same rating. In standard stock case sizes, you can get as much as 75,000 mfd at 3 volts and 1300 mfd at 350 volts.

And best of all, you can get 'em when you need 'em at your Mallory Distributor. He's your best source for all electronic components.

Another BUSS First

New BUSS VISUAL·PAK

With the clear plastic box, there's no need to open to see how many fuses are in it.

The new BUSS fuse 'Visual-Pak' originated by BUSS holds five fuses and is an outstanding development in fuse packaging.

The box doesn't have to be opened to see the number of fuses in it. This is a real help when taking inventory—and it also guards against running short on fuses.

Slide cover top securely grips bottom of box to prevent accidental spilling of fuses.

For quick identification, size and type of fuses are printed in large clear type on a flat apron on the lid of box.

The new BUSS 'Visual-Pak' fits display stands and channels—it has the same dimensions as the BUSS metal box.

Many sizes of BUSS fuses are now being shipped in the 'Visual-Pak', and shortly all sizes will be shipped in this modern package.

BUSS continues to be your profit line in fuses because—it's the complete line—it's the quality line—and it's the line with outstanding merchandising aids, such as the new 'Visual-Pak'.

BUSS®

BUSSMANN MFG. DIVISION

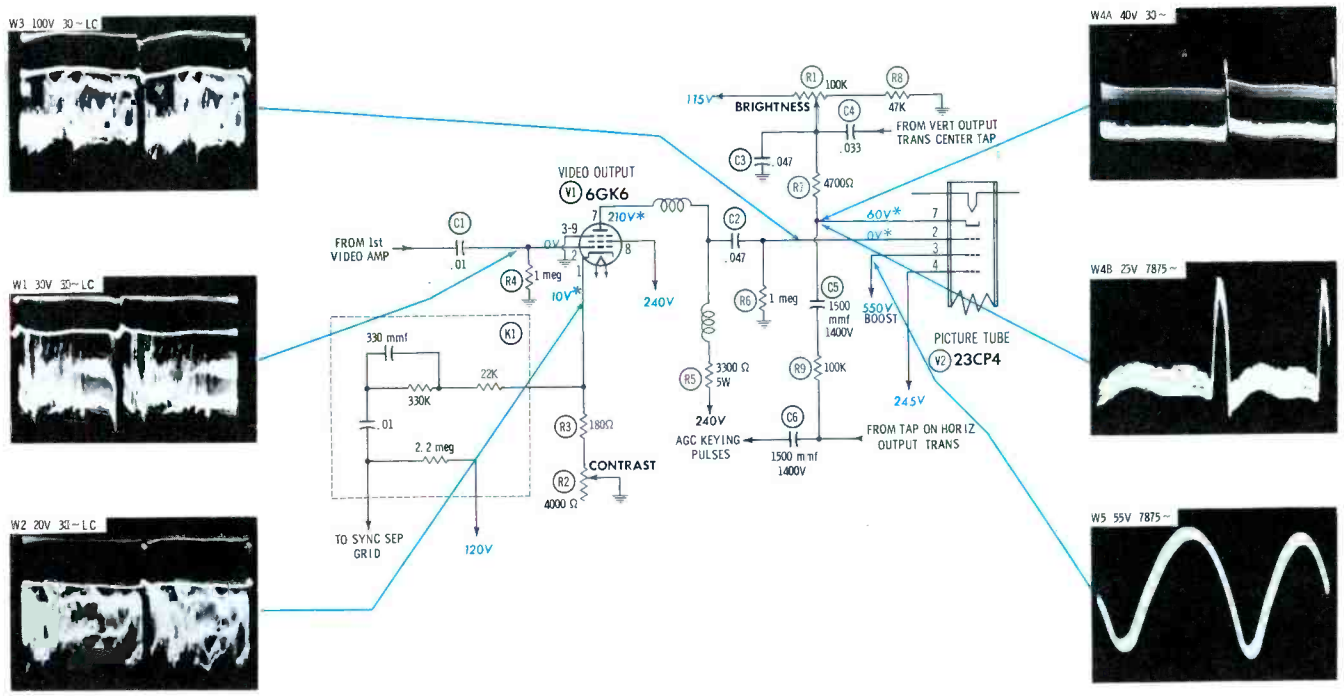
MAKERS OF THE COMPLETE LINE OF FUSES OF UNQUESTIONED HIGH QUALITY

McGraw-Edison Co. • St. Louis 7, Mo.

PF REPORTER Symfact™

DC-Coupled CRT Circuits

With Horizontal Retrace Blanking



DC VOLTAGES taken with VTVM, on inactive channel; antenna disconnected from set. *Means voltage varies with conditions — see "Variations."

WAVEFORMS taken with wide-band scope; controls set for 100-volt p-p video to CRT. Low-cap probe (LC) used where direct probe distorts signals.

Normal Operation

Although most TV sets now have single video amplifier stage that feeds output to cathode of picture tube, a few new models—and many older ones—use two-stage circuit that drives CRT grid. First video stage (not shown here) inverts and amplifies signal coming from video detector; second stage (V1 in this schematic) gives some additional voltage gain, and again inverts signal so it will have correct polarity (W3) for grid of picture tube V2. Ordinarily, signal at plate of first video stage is utilized as input to sync separator and keyed AGC, but this particular receiver—Setchell-Carlson Chassis UX163—has unusual hookup wherein second stage acts as cathode follower for sync-input signal W2. Sole output from plate of V1 is to V2, via simple RC coupling circuit C2-R6. As in most other TV sets, picture-tube bias is adjusted by varying positive cathode voltage with brightness control. W4 at cathode is mixture of both vertical and horizontal retrace-blanking pulses. Vertical-yoke input waveform (110 volts peak to peak) is impressed across C4 and C3 in series, and 40-volt portion developed across C3 is fed to V2. Horizontal pulses are derived from 500-volt sample of flyback pulse, attenuated by R9, and coupled to V2 via C5. Both types of pulses are positive, to accomplish objective of cutting off CRT during sweep retrace time. Voltage and signal ratings of V2, a 110° 23CP4, are similar to those of most other picture tubes. Accelerating anode (pin 3) is connected directly to boost source; W5 is normal boost ripple.

Operating Variations

V1 Cathode voltage ranges from 12 to 6 volts as contrast control is advanced, and plate voltage changes from 230 to 120 volts. Readings are practically same with or without signal.

V2 PIN 7 Limits of DC voltage range, at minimum and maximum brightness settings, are 115 and 45 volts (few volts higher with station signal present). Video seen in W4 is developed across R7 by fluctuations in CRT cathode current; amount of video ranges from 5 to 20 volts, depending on how brightness and contrast are adjusted.

V2 PIN 2 DC voltage remains at zero except when brightness is high and contrast is at or near maximum; then positive peaks of W3 draw grid current and generate grid-leak bias (as much as −20 volts, varying with picture content). Amplitude of W3 is 20 volts at minimum contrast; 200 volts at maximum. Since grid drive is less efficient than cathode drive, and receiver has nearly 20-kv high voltage, video requirement for normal viewing is 100 volts peak to peak, instead of usual 50 volts.

V2 PIN 3 As in most TV sets, boost voltage will vary to some degree according to load on high-voltage supply. However, this particular receiver has relatively good regulation, and boost ordinarily stays within ±25 volts of stated value.

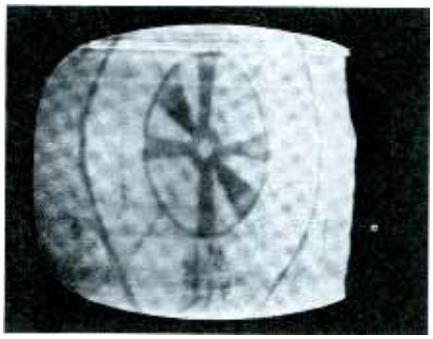
Brightness Too High

SYMPTOM 1

Raster Width
May Decrease

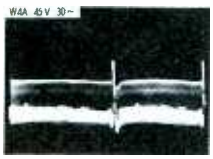
C2 Leaky

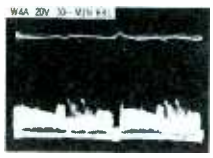
Symptom Analysis



Contrast is normal. R1 has visible effect, but does not extinguish raster. Toward upper end of control range, sides of raster pull in; flyback circuit is evidently overloaded by excessive drain on HV supply. Vertical retrace lines appear at both ends of R1 range.

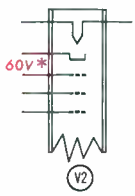
Waveform Analysis





Scope traces give only incidental clues. W3 is normal; so is W4, except for slightly low amplitude of retrace-blanking pulses. This is an odd reflection of trouble, not much help in isolating fault. With R1 at minimum, vertical blanking pulses disappear. This effect is normal, since pulses are bypassed to ground through filters on 120-volt line.

Voltage and Component Analysis



High positive voltage is found on grid of V2; it rises from 50 to 90 volts as contrast is reduced. Likely source of this voltage is leakage through C2, easily checked by unsoldering grid end of capacitor and testing for DC voltage on free lead. In-circuit ohmmeter check also gives valid clue—upscale movement of pointer (due to charging B+ filters via R5) instead of constant 1-meg reading normally expected at grid. Cathode voltage of V2 is normal at low settings of R1, but comes to rest within few volts of grid voltage as R1 is advanced. CRT then passes enough beam current to overload HV circuit and thus reduce horizontal sweep.

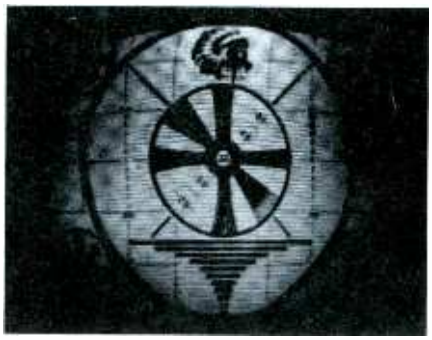
Best Bet: Analysis of voltages on CRT elements.

Brightness Too Low

Contrast Normal

SYMPTOM 2

C5 Leaky

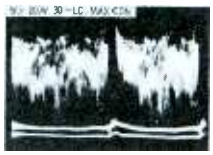


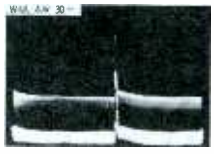
Symptom Analysis

Raster is present, but dim, on vacant channels. When a station is tuned in, brightness increases to usable level if contrast is turned up high. Some set owners would put up with this harsh-toned picture; others would recognize trouble and call for service.

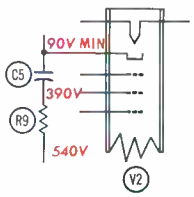
Waveform Analysis

As in symptom 1, waveforms are of slight importance. W3, if viewed while contrast control is at or near maximum setting, will show some sync compression; but this is a normal condition due to overdriving of V1. Only unusual condition in W4 is slight decrease in video content, merely a result of abnormally low current through cathode circuit of picture tube.





Voltage and Component Analysis



At cathode of V2, DC voltage cannot be reduced below 90 volts by advancing R1. Grid voltage is zero, as usual; so V2 is biased at or near cutoff, except on positive swings of strong video signal at grid. Source of excess positive voltage can be spotted by checking voltage drop across cathode-circuit resistors. Arm of R1 is less positive than cathode, so trouble obviously isn't in brightness-control or vertical-retrace circuit. But CRT end of R9 is 150 volts less positive than other end, so DC must be passing through R9 and C5. Leaky C4 will cause similar symptom, but no appreciable voltage drop will be noted across either R9 or R7.

Best Bet: Thorough voltage analysis at CRT cathode.

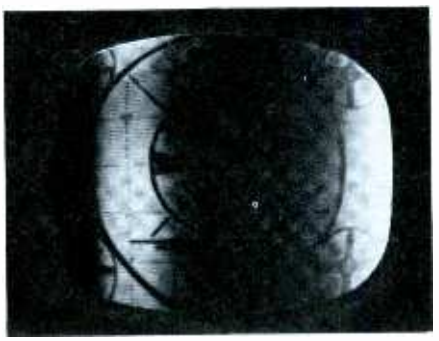
SYMPTOM 3

Raster Dim or Absent

Brightness Control Has No Effect

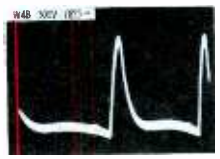
R7 Open

Symptom Analysis



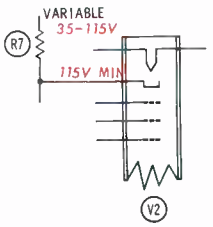
With no signal, set's own CRT has raster blanked out; 8″ check tube displays this peculiar, shadowed raster. Strong station viewed at high contrast shows fairly bright highlights, but deep black shadow areas predominate, and picture is not fit to watch.

Waveform Analysis



Surprise clue is 300-volt horizontal-pulse signal at V2 cathode. Identical pulses are found at junction of C5-R9, and normal 500-volt waveform is found on other side of R9. Some cathode-circuit defect is preventing normal shaping of horizontal blanking pulses. Waveform at arm of R1 contains correct vertical-blanking signal, clearing C3 and C4 of suspicion.

Voltage and Component Analysis



Touching VTVM probe to V2 cathode causes slight increase in brightness. On vacant channel, reading is 115 volts—unchanged by turning R1. Applying signal and increasing contrast causes rise to 150 volts. At arm of R1, voltage varies from 35 to 115 as R1 is rotated. These observations suggest that R7 is open, and high cathode-voltage reading is being produced by small cathode current through high resistance of VTVM circuit. Almost same visual symptom could be caused by open circuit between R1 arm and ground; but W4 would look normal, and DC voltage at V2 cathode would measure steady 120 volts.

Best Bet: Scope to localize; VTVM to pinpoint.

SYMPTOM 4

Low Contrast

Brightness Normal

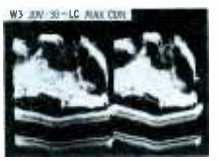
R3 Increased in Value

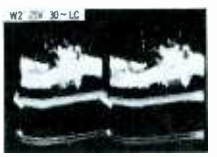
Symptom Analysis

Picture looks rather washed out and contains no snow; however, some snow (and audible noise) is noted on unoccupied channels. Contrast control is operative, but makes very little visible difference in picture. Good brightness and focus discount possibility of bad CRT.

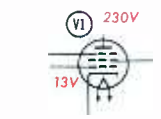
Waveform Analysis

W3 has only 20-volt amplitude at maximum contrast setting, and 10 volts at minimum contrast. Tracing back through video circuitry reveals that plate waveform of V1 is weak (same as W3), but grid waveform W1 has normal shape and amplitude. W2 is slightly stronger than normal, and does not materially change in amplitude as it should when R2 is rotated.





Voltage and Component Analysis



LITTLE AFFECTED BY CONTRAST

Plate voltage of V1 is nearly 230 volts, and varies by only a few volts when R2 is adjusted; so V1 is apparently operating near cutoff. Grid voltage is zero, as usual. Reading at cathode is 13 volts—close to normal value for minimum contrast—but decreases by only 1 volt as R2 is turned fully clockwise. Resistance to ground from cathode should be only 180 ohms at highest R2 setting, but actual reading is nearly 3000 ohms. Direct measurement across R3 pinpoints fault. Strong W2 developed across high resistance in unbypassed cathode circuit causes enough degeneration to reduce voltage gain of output stage to less than 1.

Best Bet: Signal-trace with scope; follow with ohmmeter.

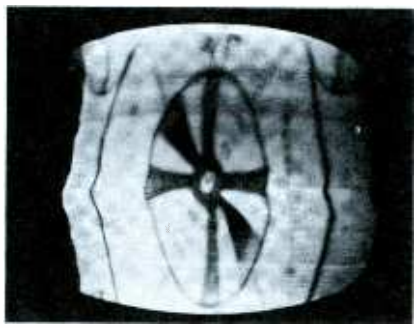
Narrow Raster

SYMPTOM 5

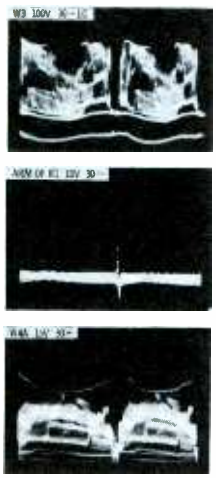
Brightness Control Inoperative

C3 Shorted

Symptom Analysis



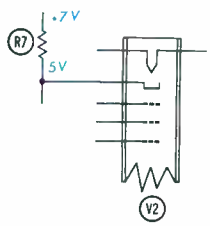
Raster fills out to nearly normal width when strong signal is applied to set and contrast advanced to maximum, but it shrinks during station breaks. Picture looks rather blurry and smeary. As in symptom 1, loss of width looks like case of high-voltage overload.



Waveform Analysis

W3 is normal except for mild increase in sync compression, which is probably related to trouble, but provides no direct clue to its location. W4A apparently contains no vertical blanking pulses, and horizontal pulses are weak; on the other hand, its video content is normal. Waveform on other side of R7 contains only vertical pulses, of 10-volt amplitude. This waveshape is normal, but amplitude should be 40 volts.

Voltage and Component Analysis



CRT cathode is only 5 volts above ground. Grid voltage is zero unless video signal is fed in; then grid-leak bias is developed in proportion to signal strength (maximum −50 volts). Arm of R1 has less than 1 volt at all control settings. Ohmmeter connected to this point reads only 200 ohms until C3 is cut loose. (Capacitor is almost, but not quite, dead short.) With bad C3 in circuit, turning R1 fully counterclockwise can damage this control by heavy surge of B+ current, so R1 should also be replaced to prevent callback.

Best Bet: Shrewd analysis of voltages is quickest way.

Negative Picture

SYMPTOM 6

Complete Sync Loss at Maximum Contrast

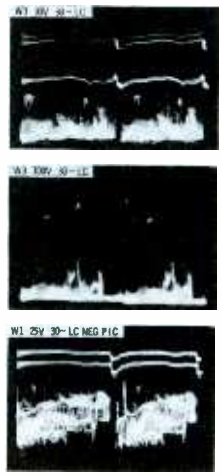
C1 Leaky

Symptom Analysis

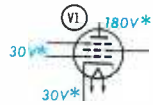
Picture is basically normal (but too weak to watch) with R2 near minimum; dark and light tones are reversed at medium contrast; normal tones return, but severe video-overload symptoms (such as sync disturbances) are noted as contrast approaches maximum.

Waveform Analysis

W3 has distortion corresponding to visual symptoms. When picture is negative, waveform polarity is inverted; when overloading is present, W3 is very distorted, with flattened sync pulses. In latter case, W1 is also seriously defective; but it shows merely a slight reduction in sync-pulse height while picture is negative. Apparently, trouble prevents V1 from inverting signal in normal manner. W2 duplicates waveshape of W1.

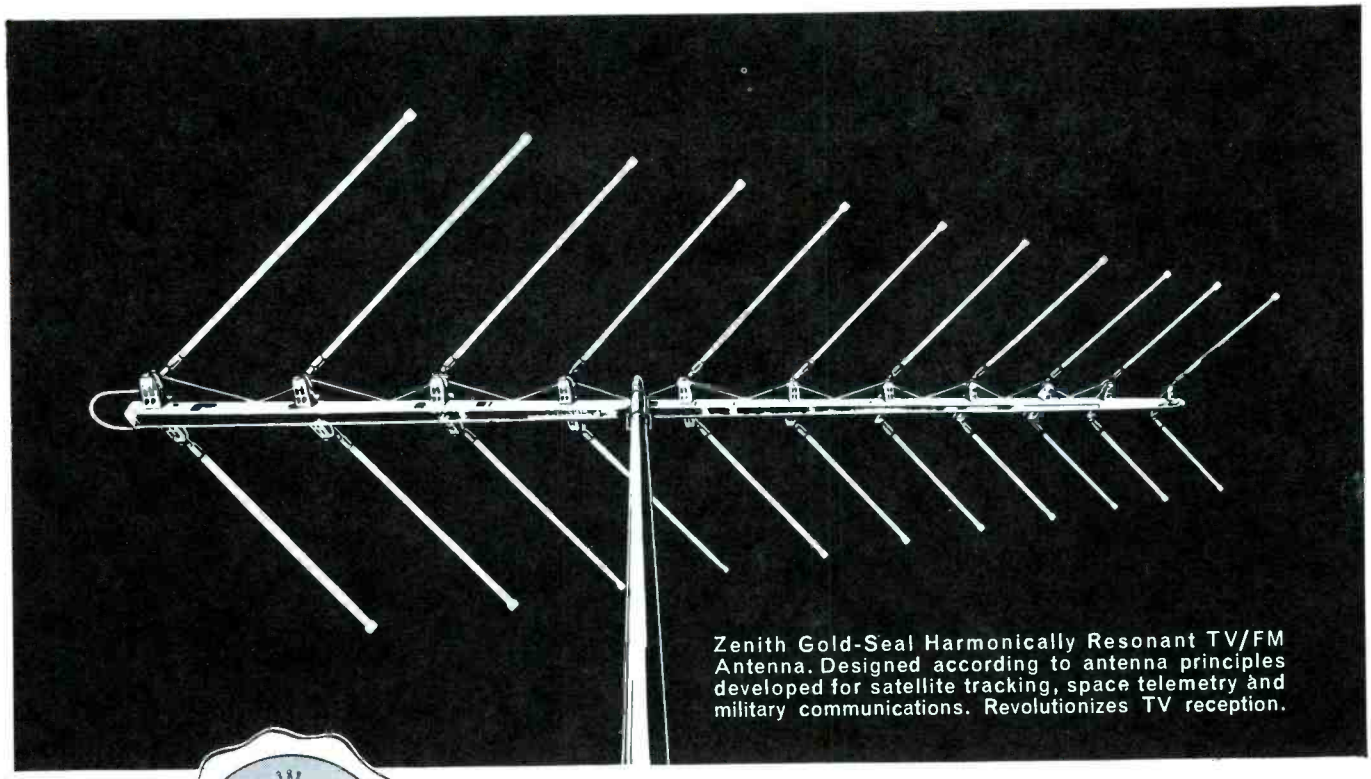


Voltage and Component Analysis



DC voltages on V1 are severely upset. Grid is highly positive, ranging from 15 volts at maximum contrast to 50 volts at minimum contrast. As a result, cathode current of V1 is extremely heavy, and cathode voltage rises to level of grid voltage (except when R2 is close to clockwise end of its rotation). Plate voltage is well below normal, indicating substantial plate current. Only obvious source of positive grid voltage is leakage in C1; this component can be given in-circuit ohmmeter check, or disconnected for voltage test, as in symptom 1.

Best Bet: Preliminary scope tests; follow with VTVM.



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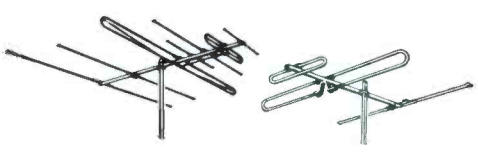
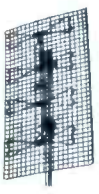
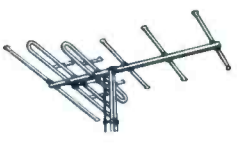


Zenith Gold-Seal Broadband Yagi VHF Antenna (Channels 2 to 13)

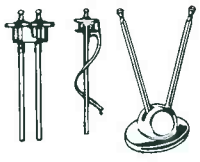
Zenith Gold-Seal VHF Folded Inline Antenna (Channels 2 to 13)



Zenith Gold-Seal UHF Stacked Bow-tie Antenna (Channels 14 to 83)



Zenith Twin Driven FM Stereo Yagi Antenna (For FM frequencies 88-108 MC)



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QUICKER SERVICING

by E. D. Ladyman

MONITORING . . .

helps spot IN TER MIT TENTS

The revenue of an electronics service shop depends mostly on the operator's ability to use his time productively, so any step taken to reduce the amount of wasted time is bound to improve the profit situation.

Servicemen know, all too well, that one of the greatest causes of lost time is intermittent troubles. Customers naturally aren't agreeable to paying a serviceman just to sit around and wait for an intermittent to "act up." To recover the cost of his time, he must make a direct attack on the problem. The time-honored method of beating on the chassis with a screwdriver, although it may make the serviceman feel better, has only limited usefulness; a more scientific approach will get quicker and surer results.

Radio-TV servicemen can learn a lesson from commercial broadcasting stations, which strive to protect their revenues by staying "on the air" every second of every broadcast day. To aid in holding "down time" to a minimum, the transmitting equipment has built-in meters for use in monitoring key check points. Potential troubles can be detected, isolated, and corrected before they cause failure of the equipment. Such a complex system of built-in monitoring devices is obviously impractical for home entertainment equipment, but the service technician can still adapt certain basic monitoring techniques to his own bench work—especially for dealing with intermittents. A methodical, pre-planned monitoring procedure will result in happier customers, greater profits, and more cheerful technicians.

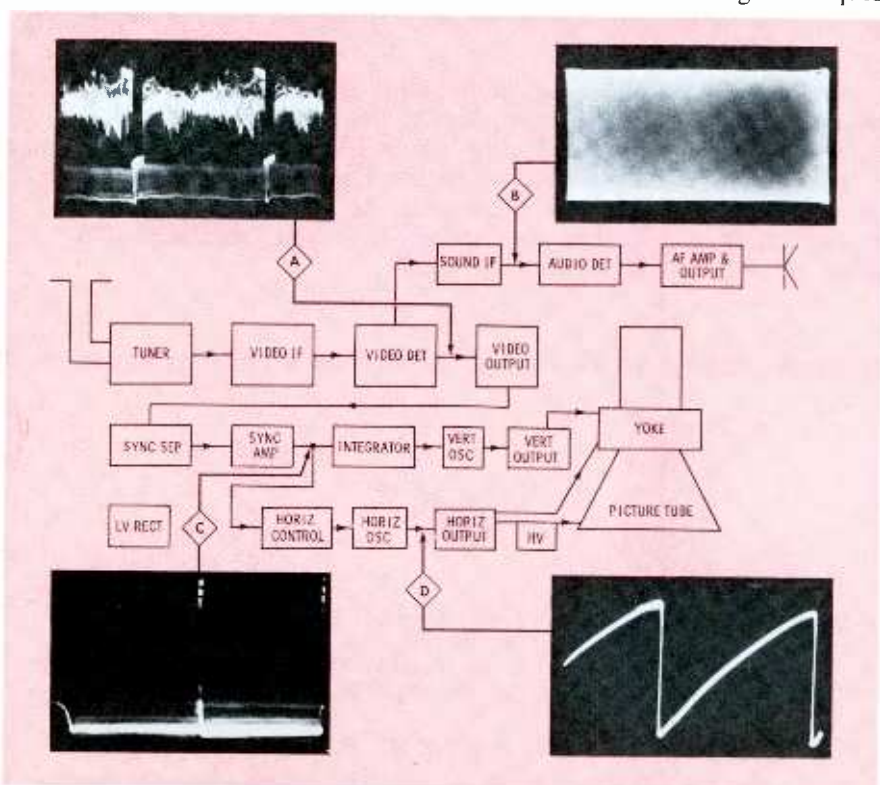


Fig. 1. Four major check points help isolate trouble to some area of set.

Why Monitor?

The word "intermittent" suggests that something abnormal is happening to a particular component as a result of changes in operating conditions or temperature. Some reaction to applied voltage or heat is to be expected, and manufacturers allow for this in the design of their sets. But if components change more than the tolerances permit, you've got trouble.

The very nature of these changes makes them difficult to detect by ordinary methods. Heat causes expansion of the materials in components, and unequal movement of different materials may cause an open or short circuit (or a change in value) that will correct itself as soon as the temperature is reduced. In addition, DC or signal voltages applied to a component can produce leakage or shorts that appear to heal when the voltage is removed. Probing the circuit with a test prod is likely to "cure" an intermittent defect, either by mechanically forcing a connection into normal contact, or by creating an electrical pulse that temporarily "welds" the faulty connection. Troubles of this type can be exasperating enough to drive a man to drink—which can be either a blessing or a curse, depending on your outlook!

The beauty of monitoring is that it eliminates the problem of shocking the receiver into normal operation. You choose the most impor-

tant test points in the suspected circuits, and hook your instrument probes to these points *before* turning the receiver on. Then you can let the equipment operate until the intermittent fault shows up, and check to see if any test indications have become abnormal. While you're waiting, you are free to work on other jobs.

Where to Monitor

The check points used in monitoring are no different from those used in ordinary servicing, but since you can make only a few tests during each monitoring period, you must pick your check points with extra care.

The first step is to try isolating a defect to some definite section of the equipment; once you've ascertained that a certain group of stages is not operating normally, you can monitor various secondary check points in the area to close in on the trouble. In TV work, this initial phase of trouble isolation depends on a shrewd analysis of the picture and sound symptoms—the same method routinely used by all TV men to decide where to begin troubleshooting. However, intermittents cause special complications, because you may have to depend on the customer's description of the symptom (not so much *what it is* as *when it appears*). It's important to get a thorough understanding of his complaint. Sometimes it helps to ask leading questions, such as, "Does the trouble appear only about suppertime?" or "Do you have to reset this control every time you turn the set on?"

The choice of a primary test point may be easy if the set has a symptom such as "creeping" vertical nonlinearity, which plainly indicates a defect in some small area of the set. But quite a few symptoms, like intermittent loss of sync, aren't so easily pinpointed to a stage—or even within several stages. If there is any doubt about the general location of the fault, or if you're not sure of the customer's complaint, you'll find it helpful to begin monitoring at one or more of the four major check points marked on the block diagram in Fig. 1:

A—Output of video detector
B—Input to audio detector
C—Output of last sync stage
D—Drive to horizontal output

Using these points, you can break up the circuits into manageable sections, and greatly reduce the number of tests needed.

How to Make It "Intermit"

Unfortunately, you can't even make that first test until you can coax the trouble to show up. You have several possible ways of doing this, but before doing anything, stop and think. Is the *trouble* really intermittent, or only the *symptom*? Even if the set seems to be acting normally, go ahead and make a few key checks with the scope and VTVM. You may spot some borderline fault such as compressed sync in the video signal, low or poorly filtered B+ voltage, or a misadjusted horizontal oscillator, which may explain why the set's operation is rather erratic.

If the "normal" readings seem correct, you'll have to duplicate the conditions that cause the breakdown, to eliminate the possibility of the set operating normally on your service bench for endless hours. Most customers are unhappy when told the trouble could not be found, and are prone to take such reports as personal affronts to their intelligence. Thus, we repeat: listen very carefully to their accounts of the trouble. Frequently, the complaint will contain a statement such as, "If I want to watch an 8 o'clock program, I turn the set on at 7," or "It runs about an hour, then off it goes." These are clear signs of *thermal* intermittents caused by changes in temperature. The first type of complaint indicates trouble during warmup, which can be made to appear with comparative ease. The chassis will stay much cooler on the service bench than in the cabinet, thus prolonging the warmup time. If necessary, a strategically-placed fan or two can forestall normal heating. When the trouble does go away, a shot of "freeze spray" chemical will often bring it back; by carefully aiming the spray, you can pinpoint the offending component.

(A) Typically caused by loss of AGC

(B) Possible result of misaligned IF

Fig. 2. Distortion of detected video.

The other type of complaint, a "hot" intermittent, is much more difficult to bring forth, because the chassis may never run hot enough on the bench to induce the trouble. Heat lamps directed at the suspected area have been used effectively for years, but this method has certain disadvantages. The intense heat radiated by the lamp can melt wax and other insulation from components in the area, possibly causing other troubles or even producing a temporary cure of the original fault. A preferred method is to cover the chassis with a material that will hold heat in much the same manner as a cabinet. Ideal for this purpose is a large cardboard box. If you're using a monitoring technique, you've already made the test connections, so you don't need to reach under the box.

Intermittent troubles that can't be tied to temperature variations may be due to component breakdowns that occur under certain line or signal voltage conditions. Such cases demand more observation and experimenting than simple heat problems; again, the important thing is to come as close as possible to the conditions under which the owner operates his set.

Down to Business

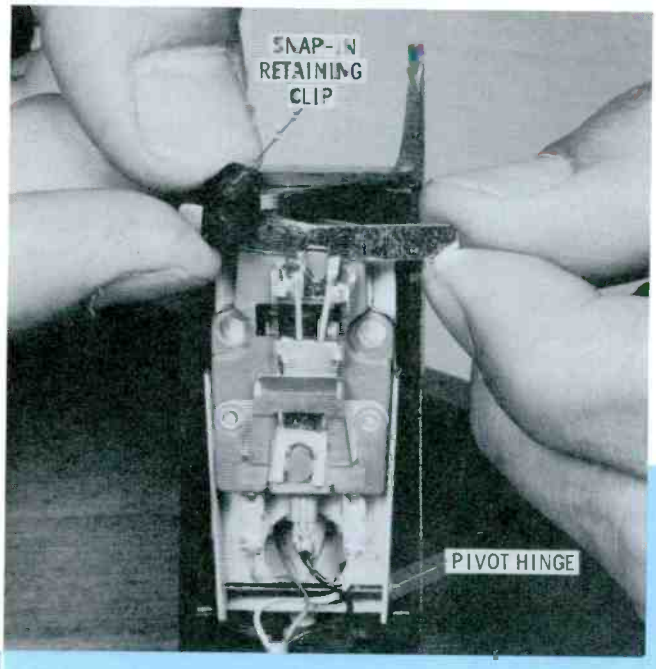
Once you've decided which check points to monitor, and how to induce the symptom, you're "halfway home" on conquering the intermittent. To go the rest of the way, let's consider what to look for at particular test points.

A—Video Detector

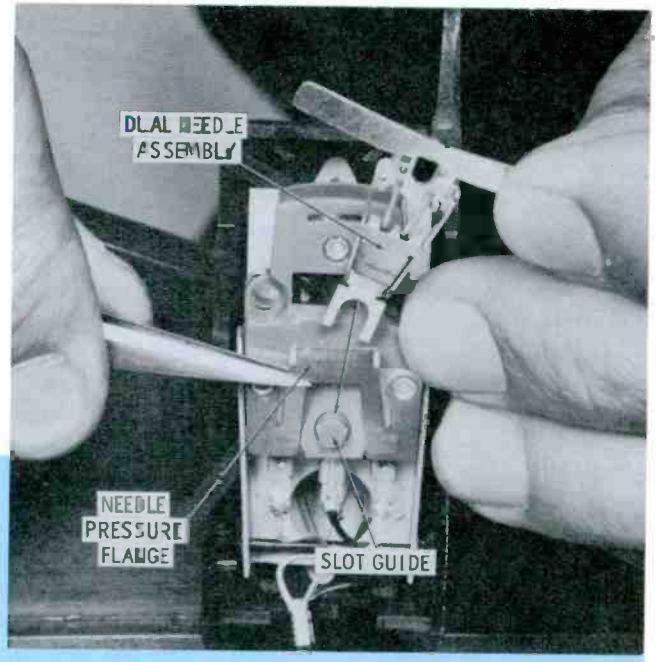
This point is useful for isolating the cause of weak video with no snow, or touchy sync. (This test isn't necessary to troubleshoot the

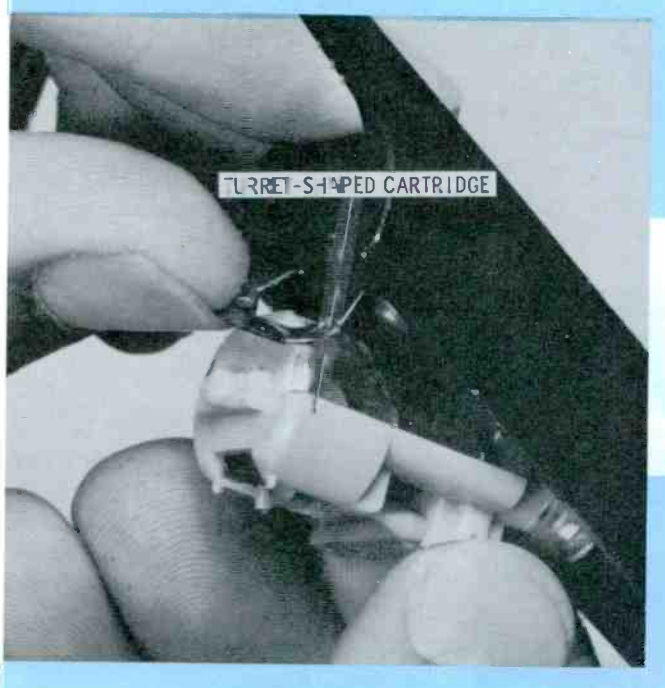
• *Please turn to page 71*

replacing the phono NEEDLE

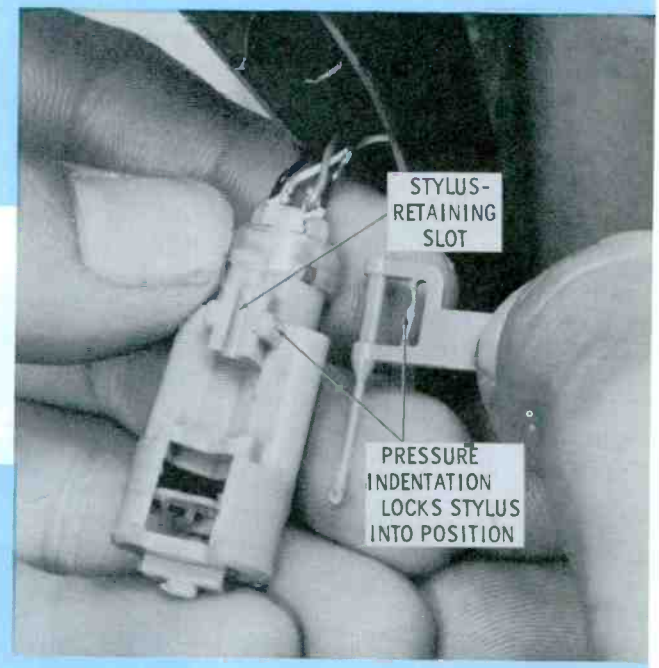


This is one of the new "floating-type" cartridges on the market this year. The snap-in clip marked in the first photo holds the front of the cartridge in place, and blocks the extraction of the dual needle assembly. After this clip has been taken out of the way, the needle assembly can be replaced as shown in the second photo. Using a pointed-nosed tool to apply pressure to the rear retaining flange, slip the needle assembly slightly sideways, out, and away from the cartridge. Just reverse the above procedure to snap in the new unit.



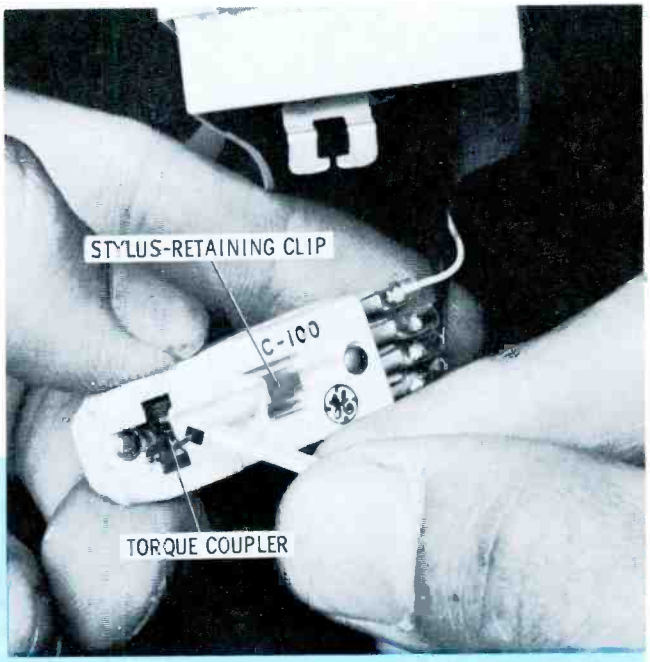


Depicted in these photos is one of the new turret-shaped cartridges. As the trend towards snap-out cartridge mountings increases, replacing the stylus becomes an easier task. Being able to remove the cartridge lets you see exactly how the stylus is mounted, making it easier to remove and replace. The photo of the stylus separated from the cartridge will give you a better idea of how the stylus is held in place. This cartridge and the stylus lever are made mostly of a plastic material, and it's a simple job to unsnap the stylus from the cartridge. However, you'll find it takes a good firm pull to release the stylus from the retaining slot, in this type of assembly.



Replacing a phonograph needle usually presents no problem to the technician active in the servicing of high-fidelity equipment. However, for those not too familiar with some of the newer phono cartridges on the market, installing a new needle can be quite a trick. Many different types of cartridges are appearing in today's home entertainment equipment, and most of these are dual-needle types for playing both microgroove and 78-rpm records. Needle changeover is sometimes accomplished by means of a flip-over cartridge, while in other cases, only the stylus rotates—the rest of the assembly remains stationary. Shown in these photographs are four of the most common types of new cartridges, illustrating the correct procedures for changing a stylus without damaging cartridge or needle.

When a clip-held cartridge is used, the stylus will be easier to remove if you first release the cartridge-retaining spring, and drop the cartridge away from the tone arm. This may be the only way to reach the stylus, if tone-arm travel in the upward direction is limited. In the cartridge shown, the



turnover stylus is held in place by a metal retaining clip. After lowering the cartridge away from the tone arm, move the stylus to the center position, and pull it forward and away from this clip. When a new stylus is installed, make sure its shank fits into the V-shaped torque coupler.

This type of cartridge is another that can be released quickly and dropped down from the tone arm. Sometimes, though, it's unnecessary to remove the cartridge, again depending on the tone-arm clearance—whether it can be raised high enough to remove the stylus conveniently. The stylus in this cartridge can be extracted in much the same

manner as the similar type shown in one of the other photos. Move the turnover stylus to the halfway point, and pull up and out to remove it from the metal retaining clip. When replacing the stylus, make sure the shank is properly seated in the coupling saddle, to insure accurate transmission of audio information from needle to cartridge.

Servicing Industrial Electronics by Edward M. Noll

INTERCOMS

with all the EXTRAS

Intercommunications is rapidly emerging as an entirely separate branch of electronics. From simple carrier-current arrangements to the most elaborate multiunit systems, intercoms are commonplace in large factories and offices, smaller businesses (such as grocers and garages), and even private homes. Except for the largest industrial and commercial companies — who may have their own electronics service personnel — most intercom users need to call in a qualified independent technician to lay out, install, and service their particular systems.

Although there are many types of installations involving many different models of intercoms, the differences among systems are concerned mostly with the number of stations and the variety of extra features included. In reality, all intercoms are *basically* the same. An intercom station comprises a speaker (which generally also serves as the microphone), a tube-type or transistorized audio amplifier, and anything from a simple *Talk-Listen* switch to an elaborate control panel equipped with all the "extra" features. The fundamental requirements of the audio amplifier and speaker remain fairly consistent throughout the range of different models—although, of course, the units may vary somewhat in design and output power. On the other hand, the amount and type of switching circuitry is dependent upon the features of the system and the overall number of units. The more features, generally, the more switch or relay contacts involved; thus, the more interconnecting wires employed.

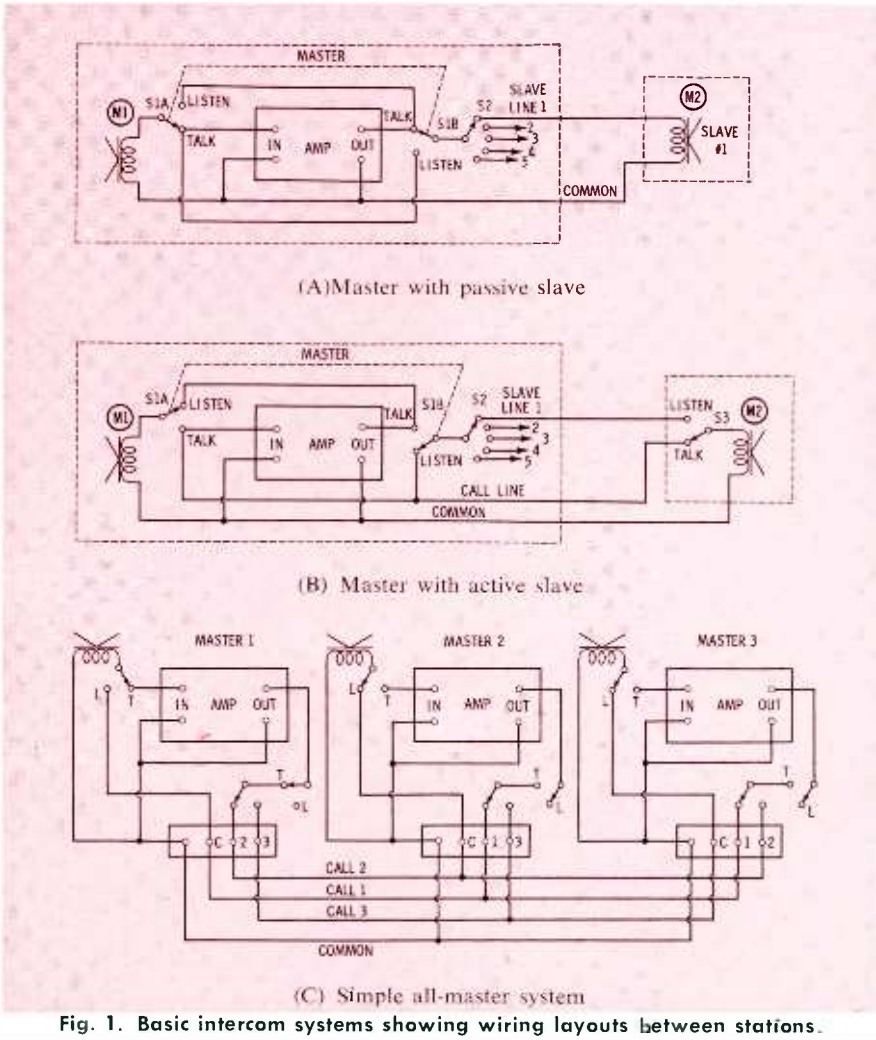


Fig. 1. Basic intercom systems showing wiring layouts between stations.

Basic System Design

Fig. 1 shows three fundamental intercom arrangements. In each case, (the designation *master station* means a control point for an entire intercom system. Slave stations are simpler units with few or no control features.

Master with Unswitched Slave

In the simple arrangement of Fig. 1A, the only component in the slave station is speaker-microphone M2. Selector switch S2 chooses the desired station by number. Then, when the operator at the master station moves talk-listen switch S1 to the "talk" position, he is able to call a particular slave station. Notice that master speaker M1 connects to the input of the amplifier, and speaker M2 connects to the output. When S1 is transferred to the listen position, M2 is connected to the input of the amplifier and M1 to the output, so the slave station can be monitored. In this type of system, no calls can be initiated from any slave station unless that station is switched into the circuit

by selector switch S2 at the master station.

Master with Switched Slave

Fig. 1B also illustrates a master and slave combination. Here, however, it is possible for any slave to initiate a call to the master station. Otherwise, the circuit operates the same as that in Fig. 1A.

To call the master from a slave station—assuming the master station is on—switch S3 is set to the talk position. M2 is thus connected to the input of the amplifier and M1 to the output. To reply, the operator at the master station sets selector switch S2 for the correct slave station. From here on, the system operates as in Fig. 1A, spring-return switch S3 having returned to its normal position.

Some slave-station units are available with an additional switch position that prevents the master unit from eavesdropping.

Note that in Fig. 1B it is necessary to run three wires between the master station and each of the slave units. In Fig. 1A, only two wires link the master station with each slave.

All-Master System

The third basic intercom arrangement is the all-master plan of Fig. 1C. In this system, all stations have an amplifier plus controls and switching arrangements. Hence, any station is able to initiate and establish contact with any other station or stations. Although this arrangement does provide complete versatility in an intercom system, a multiconductor cable must be used to join the various master stations together in a parallel arrangement. It is well to keep in mind that the cable for a given all-master installation must contain one conductor more than the number of interconnected master stations (i.e., six stations require seven wires).

A modified version of the all-master system, consisting of a number of master stations plus a number of slave units, reduces both the cost of the system and the number of conductors needed.

Selling Versatility

Modern intercom units and associated items permit the installation of versatile systems that can accommodate the needs of practically all commercial and business enterprises. For instance, slave units can be wired to initiate calls selectively to any one or several master stations. Thus, in a multiple master arrangement, a number of conversations can be going on privately. Indicator lights can be included to show what circuits are in operation, or to inform the person initiating a call that his signal is going through. Some master stations even include lights that indicate which station is calling.

Many other convenient features and accessories are available for specialized applications. For example, in certain industrial and business locations where the noise level is so high that ordinary intercom operation is impossible, the telephone handset is the answer. Some telephone sets have a bell or buzzer which signals the operator to the handset intercom. Others feature coded bell or light signals to attract the attention of specific individuals. These annunciator facilities are also becoming increasingly popular as "extras" in speaker-equipped intercom systems.

Large industrial and business establishments often use paging systems to call an individual to the nearest intercom or telephone. This is particularly effective in attracting the attention of those persons who normally move about into various areas. Many establishments already

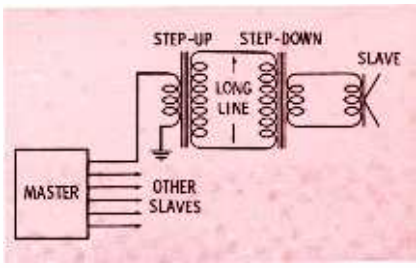


Fig. 3. Line transformers help reduce the line losses between stations.

have wired music-PA installations which are used also for intercom paging.

In large installations, intercom, paging, and wired-music systems are frequently integrated; either combined program and intercom amplifiers, or separate amplifiers (as in Fig. 2) may be used. Normally, the program material is sent over the wires to each of the slave units. The master operator, however, can cut in and call any slave unit by depressing the appropriate switch. In so doing, the intercom path is established to that particular slave, and the program material is turned off. The program is interrupted only at the slave station being contacted—not at any others.

All-station paging can be accomplished by setting the master station selector to the all-call position. In this case the output of the intercom amplifier is fed to the input of the program amplifier. Since the output of the program amplifier

• *Please turn to page 67*

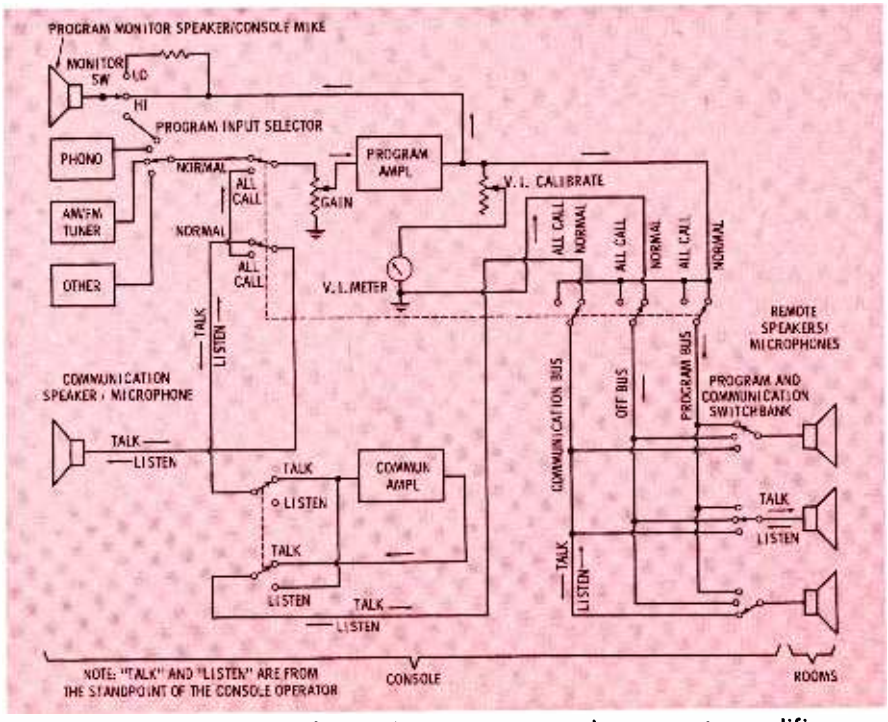
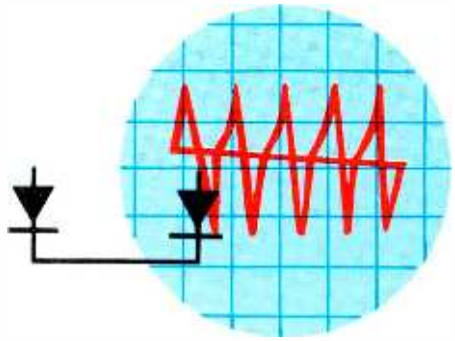


Fig. 2. Block diagram of music-intercom system using separate amplifiers.

Shop Talk

by Allan F. Kinckiner

SCOPING COMMON-CATHODE HORIZONTAL AFC



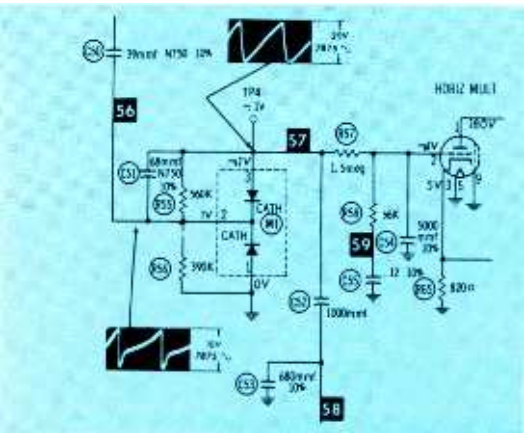


Fig. 1. Common-cathode AFC circuit requires only one sync-pulse input.

Most TV sets of recent design, and even some of the old-timers, use a type of dual-diode horizontal AFC circuit that differs somewhat from the "balanced" circuit I described in the June *Shop Talk* column. This alternate circuit, which uses selenium or vacuum-tube diodes with a common cathode connection, might conveniently be called "unbalanced" diode AFC without implying inferiority to the balanced circuit. Both arrangements are equally capable of supplying efficient, stable, and quick-acting horizontal synchronization.

The unbalanced circuit has some advantages and also some disadvantages when compared with the balanced type. In its favor is the fact that it requires only one sync pulse, of negative polarity—making it usable in receivers having a single-stage sync circuit. Also, because it can accept a sample sawtooth signal with the steep slope running in a negative direction, it is possible to obtain a usable sample signal from the negative spike of the horizontal drive waveform—thus eliminating the output tube and flyback from the AFC feedback loop. Dual diodes with a common cathode are available in many different types of multisection tubes, and this factor greatly simplifies receiver design. All of these advantages add up to a welcome reduction in cost when the unbalanced type of diode AFC is used.

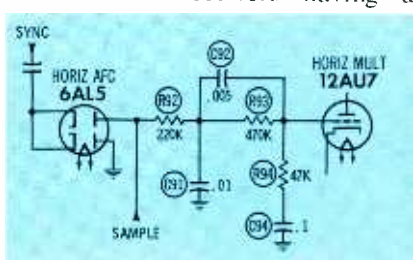


Fig. 2. Some sets, like Westinghouse V-2216, have elaborate AFC filter.

On the debit side of the comparison ledger, the unbalanced diode AFC develops a more negative than positive correction voltage, instead of being zero centered. Therefore, it makes frequency or phasing corrections more effectively when the oscillator is running slow (or is lagging the sync signal) than when the oscillator is fast. This disadvantage is not serious; it is usually counteracted by using a different shunt resistance across each diode, applying slight positive bias to the AFC, or designing the horizontal multivibrator so it will operate properly with a slight negative voltage on the AFC-controlled grid. When the unbalanced AFC circuit is used with horizontal oscillators other than multivibrators—for example, the sine-wave oscillator and reactance tube — this disadvantage actually becomes an advantage.

Circuit Action

Fig. 1 shows a modern version of the common-cathode circuit, using selenium diodes. Its operation is fundamentally the same as that of the balanced circuit: When the oscillator runs fast, or leads the sync, the combined action of the sync and sample waveforms develop a positive correction voltage which is fed through a filter to the controlled grid of the oscillator or multivibrator. Conversely, when the oscillator runs slow, or lags the sync pulses, a negative voltage is developed.

Generally, the unbalanced circuit can operate with a smaller sync pulse than the balanced circuits; in some cases, 5 to 10 volts is an adequate peak-to-peak amplitude. The sample signal may have from two to five times as much amplitude as the sync-pulse signal.

The circuit's greater ability to correct a below-frequency or lagging-phase condition can be demonstrated by turning the hold control off frequency in either direction and slowly turning back toward synchronization. With the unbalanced circuit, five bars—slanting to the right—are seen just before the picture pulls into sync, but the pull-in point in the other direction is not reached until only three bars are seen slanting to the left. This obser-

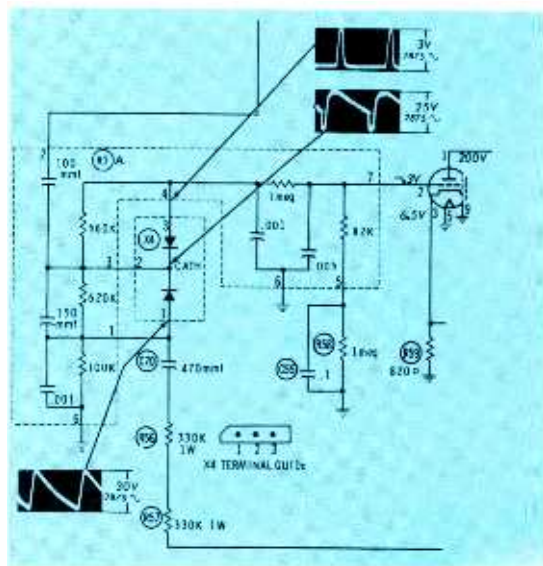


Fig. 3. Different method of applying sawtooth to common-cathode circuit.

vation is mentioned to emphasize the fact that unequal pull-in does not indicate an AFC defect except in a balanced circuit, which should pull in equally from either direction.

Some unbalanced circuits use a relatively large number of components in the correction-voltage filter circuit. Let's analyze one example of a complex filter, as used in a Westinghouse V-2216 chassis (Fig. 2): The combination of C91-R92 is primarily a short-time-constant, low-pass filter; C92-R93 is a noise-immunity network; and C94-R94 is a long-time-constant, low-pass filter. The low-pass filters prevent fluctuations of the correction voltage, and the noise-immunity circuit does just what its name implies—it makes the oscillator less sensitive to noise.

Another variation of the unbalanced circuit is shown in Fig. 3. The same negative-going sync signal is used, but the sawtooth signal is reversed in polarity (with a short positive-going slope). This sample signal is fed to the diode terminal farthest from the multivibrator—just the opposite of the arrangement used in Fig. 1. A resistor is inserted between this diode terminal and ground, to complete the DC ground path without shorting out the sawtooth signal. The correction-voltage output is almost the same as in Fig. 1.

The sawtooth signal for the circuit of Fig. 3 is shaped from a large positive pulse taken from the flyback circuit, just as in a balanced AFC system. (The shaping networks were discussed in the June issue.) I'm inclined to consider this feature a disadvantage, since I have seen too many troubles develop in sample-signal networks which derive a signal from a large pulse.

Troubles and Troubleshooting

The same troubles that afflict the balanced AFC circuit—leaky diodes or coupling capacitors, distorted input signals, etc.—are also found in the unbalanced AFC, but the latter type is more critically affected by tolerance errors or minor defects in components. The unbalanced type is also not so easy to troubleshoot as the balanced type. For one thing, the horizontal oscillator is not likely to have exactly zero voltage on its controlled grid for normal operation, as is usually the case with the balanced circuit. Consequently, the

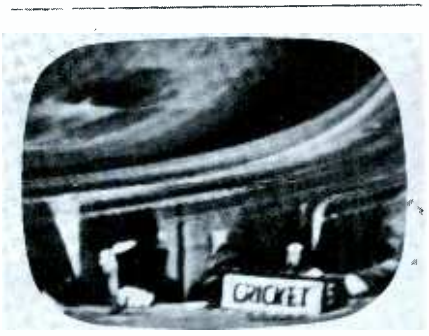


Fig. 4. AFC-circuit trouble allowed top half of picture to "tear loose."

free-running operation of the oscillator is not so easily checked by simply grounding the controlled grid. To bring the oscillator to 15,750 cps, it may be necessary to reset the horizontal frequency adjustment or else substitute an external bias voltage for the AFC voltage.

Nor is the unbalanced circuit as easy to check with a scope, because the shunt resistors and capacitors cause a certain amount of interaction between the sync and sample signals even when the diode unit is removed. In spite of this, scope examination of these signals still turns up most causes of poor AFC action. One case where scope tracing proved its worth involved a Philco 9L35 which presented the partial tearout shown in Fig. 4. Since the lower half of the picture was normal, I knew the oscillator was running on frequency, and "guesstimated" that the AFC was at fault. After inserting a test adapter in the 9BR7 socket, I scoped pins 7 and 8, where the sample signal and sync are respectively fed to the AFC. The signals I found at these points are shown in Figs. 5A and 5B. From the absence of a sawtooth wave, I deduced that K6 in Fig. 6 (Philco part number 30-6512-6) was defective. Installing a new unit restored normal AFC and sync action. I again scoped pins 7 and 8, and this time the traces appeared

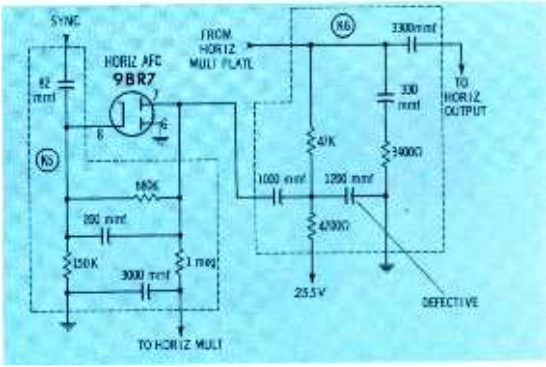


Fig. 6. Loss of sample sawtooth was traced to open capacitor inside K6.

as in Figs. 5C and 5D.

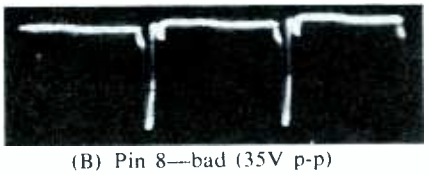
To obtain an illustration of my previous statement about the interaction between the AFC sync and sample signal even with the diode removed, I took an old 12AU7, snipped off pins 6, 7, and 8, and installed it in the 9BR7 socket. Pin 7 still scoped the same as in Fig. 5C, as expected, but pin 8—where a pure sync pulse might be anticipated—was just barely different from Fig. 5D.

A Tough Old Bird

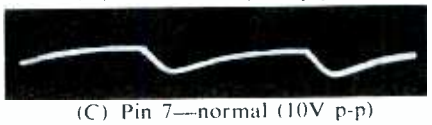
Sometimes even the scope can't directly pinpoint the cause of AFC trouble. A fellow serviceman confronted me with a Westinghouse V-2216, using the circuit of Fig. 2, which he said was too critical in locking. "Look," he challenged, "I know these sets are normally critical, but this one is worse than it should be." I checked it and found he wasn't just "whistlin' Dixie"; the set was really touchy. Using up every troubleshooting trick I could think of left me exactly where I was when I started. Scope traces were perfect, and voltages were right on the ball, but AFC action was still lousy. Finally I examined every part in the circuit and came up with a .001 capacitor in the noise-immunity network of the correction-voltage filter, where a .005

• *Please turn to page 68*

(A) Pin 7—bad (45V p-p)



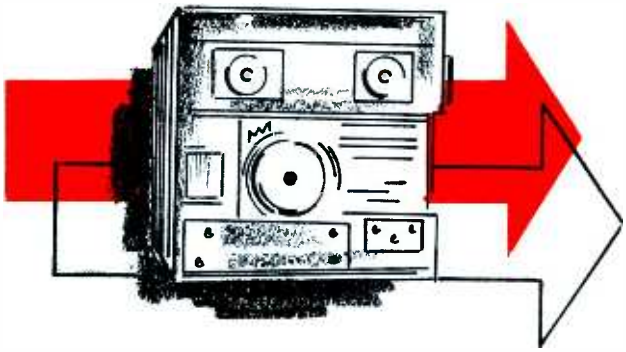
(B) Pin 8—bad (35V p-p)



(C) Pin 7—normal (10V p-p)

(D) Pin 8—normal (10V p-p)

Fig. 5. Normal and abnormal waveforms from AFC tube of Philco 9L35.



TAPE RECORDERS

Yield to a DIRECT approach

But it's well to keep these special troubleshooting pointers in mind.

by Larry B. Allen

One afternoon not so long ago, a serviceman friend dropped in for a "casual" visit. We made small talk, and bragged about business; then, somehow, the conversation turned to tape recorders.

"You know, I dread to see a tape recorder brought into the shop!" he complained. "They always seem like so much work for the little dab of money you get for servicing them."

"Oh, I don't know," I replied, "I always charge enough to cover my time when I service one. In fact, I sort of enjoy whipping a troublesome machine into shape."

"I'll be right back . . .". He was out the door and back in less time than it takes to tell, lugging a tape recorder of rather recent design. "Here's one you might enjoy whipping into shape. Electronic faults I can find easily, but these mechanical defects keep me snowed!"

Wishing I'd known when to keep quiet, I countered by asking him what sort of trouble he was having with it and hinting that he should be able to fix it himself.

"I know it," he admitted, "But it seems the only way to service one of these monsters is by the guess-and-try method. And I usually end up spending a whole day at it. Then I'm ashamed to charge for so much time."

I could see what he meant, because no customer would want to pay the cost of a day of *my* time just for getting one tape recorder fixed. So I figured here was my chance to do a good turn and pass along my method of attacking tape-recorder service. My friend acted pleased at the chance to learn a better approach to his problem (although I'm sure he came by with no other purpose in mind) . . . and I must admit the prospect of showing off my ability didn't strike me as a bad idea, either.

Now let me hasten to add, I'm no expert—and there's a lot about tape recorders I hope to learn by continuing to service them. But I've developed a "philosophy" of servicing that I felt my friend should know about, and I think you'd like to hear about it, too.

I believe in the direct approach. I used to waste a lot of time trying to "analyze" the problem before I even took the top off the recorder. If the trouble is mechanical, you're going to take the top off anyway, so why not do it to start with? If you consider the logic of this approach, it makes sense. The time to analyze mechanical symptoms is *after* you expose the parts involved. Also, you can't possibly repair the mechanism until it's visible, so why hesitate? The toughest part of any job is getting started, and disassembling the machine gives you something to do while you're thinking about the trouble.

Before going to work on the problem, I clamp the transport deck into a dolly of the sort used for record changers; this places the unit clear of the bench where I can observe its operation without upending it. As I demonstrated to my friend, a small pocket flashlight helps me see into shadowed corners.

Classifying Faults

With my friend's recorder all set up for bench analysis, I was ready to explain how to diagnose the problem. Mechanical defects in a tape recorder fall into a very limited group of categories, as far as their effect on operation is concerned. Most of them affect *tape drive* (the action of transporting the tape from one reel, across the magnetic head, and winding it up on the other reel). The various possible drive troubles can be grouped as affecting the capstan drive (fairly common), take-up-reel drive (also common), unwind-reel drive, or rewind (running the tape back onto the unwind reel).

Capstan Drive Troubles

These are faults that affect the drive mechanism for either playback or recording. In most machines, anything that affects one mode of operation will affect the other, but occasionally this isn't so. Drive troubles may occur in several ways.

"Wow" may be heard when a tape is played on the machine, indicating slippage in the mechanism that drives the capstan. A below-deck inspection will usually reveal a drive wheel with hardened (or oily) rubber, a loose or weak pull-in spring (the one that holds the drive wheel against the capstan), or a slipping drive belt. In any case, the remedy is obvious.

In belt-driven machines, slippage may mean the drive belt has accumulated a deposit of oil from the mechanism and lost traction; on the other hand, it may simply have become stretched. In a few machines, the belt drive can be kept tight by an adjustable "idler" roller that makes it possible to take up the slack as the belt stretches through continued use. In this way, a longer period of service can be obtained from a rubber drive belt. When the idler adjustment nears its end, be sure to replace the belt; it's about finished.

Sometimes capstan-drive systems will fail to work because the pressure roller, which holds the tape in contact with the capstan, will become hardened or oily. This can be seen without even peering under the deck, but the top must be off:

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thus you see why I remove the top, very first thing. The cure for a bad pressure roller, as with most faulty drive parts, is a replacement. I've "livened up" a few by placing them in contact with the wire buffing wheel on my grinder, but this is only a last resort if a replacement is unavailable. A thorough cleaning with alcohol is acceptable if oil or grease is the only problem; but the deterioration has already started, and a replacement is best.

Takeup-Reel Drive

Defects which affect takeup action usually show up by frequently broken tapes, by tape pileups in the mechanism or on the deck, or—in a few machines—by "wow" in the playback.

Takeup drives can become either too loose or too tight. The normal drive ratio is such that the takeup reel tries to turn a little faster than the capstan; thus, the normally acting takeup reel pulls gently on the tape after it leaves the capstan, keeping all the slack out. Notice I said a *normal* reel pulls gently, and the takeup reel *tries* to turn faster than the tape is fed. A clutch arrangement, either between two flat rubber surfaces or between a rubber belt and its metal track, allows the small amount of slippage necessary to prevent snapping the tape apart.

If the slippage becomes too easy, the reel turns too slowly and the tape piles up. If the clutch is too tight, it either pulls the tape through the capstan in an irregular manner (causing "wow") or breaks the tape. A common form of takeup-reel trouble is a fluctuating tension that alternately loosens and tightens the tape between the reel and capstan, frequently resulting in breakage.

A third type of takeup drive—not seen too often—is the pressure-roller drive. The pressure roller is generally driven by a rubber belt; therefore, the same forms of trouble that affect capstan drives can be expected with this type of takeup mechanism. The important difference is that the takeup drive *must* slip a little, while the capstan drive *must not* slip at all.

Unwind (Followup) Reel

During either playback or recording, the reel of tape that's full at the start can't run as fast as the tape-

drive speed; otherwise, it would "push" tape toward the magnetic head and the capstan, resulting in a pile of tape on or in the deck. Therefore, this unwind reel (often termed the "followup" reel) must apply a gentle holdback action to the tape, so it will be fed smoothly across the tape head and to the capstan.

In some machines, this is done by setting up the drive ratio so that the unwind reel tries to turn more slowly than the tape drive. As with the takeup reel, a certain amount of slippage allows the tape to pull on the reel and make it rotate at a speed different from its "natural" tendency, thus keeping the tape tight. At the unwind reel, too much slippage will allow the tape to pull the reel too fast, resulting in erratic "bouncing," and ultimately causing a tape pileup. If the slippage is insufficient, and the tape is kept too tight, "wow" is likely and breakage is pretty apt to occur soon.

Rewind Problems

The "Rewind" position of the recorder switch causes the unwind reel to turn backwards at a high speed—to rewind the tape rapidly. This necessitates a change in drive ratios, because in forward speeds the reels turn more slowly.

In some recorders, the unwind reel is simply held by a sort of brake during recording or playback (so tape doesn't pile up); thus the drive mechanism can be "thrown into gear" by the "Rewind" button, and the high-speed rewind can proceed. In others, a mechanical change in the drive system—say, from pressure roller to drive belt—accomplishes the change in drive ratios. In most machines, switching to "Rewind" also releases the tape from close contact with the magnetic head. As pointed out earlier: With the top off, and the machine in a position for easy inspection, figuring out the drive system is greatly simplified. Go directly to the section indicated by the symptoms, and your job is half over. Often a simple adjustment is the answer; other times a simple replacement or cleaning job is sufficient.

Replacing Drive Parts

As I pointed out to my fellow serviceman, probably the single most difficult item to replace—at

New TRANSISTOR RADIO ANALYST

makes it Easy and Profitable to Service all Transistor Radios

B&K Model 960

TRANSISTOR RADIO ANALYST

with Exclusive DYNA-TRACE Single-Point Probe—and Built-in Metered Power Supply and VTVM

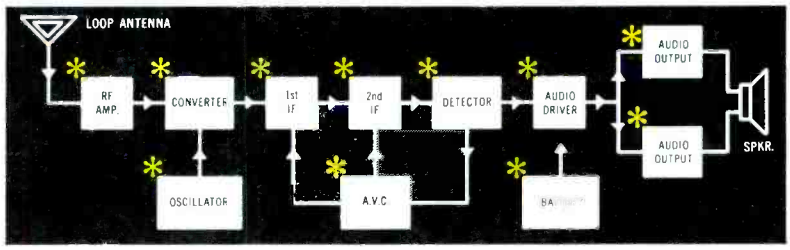
Complete Transistor Radio Service Shop in One Instrument

Signal-Generator, Power Supply, Milliammeter, VTVM, Battery Tester, Ohmmeter, and Both In-Circuit and Out-of-Circuit Transistor Tester—All in One

Also Speeds Servicing of Tube-Type Radios

Check all circuits - Pinpoint any trouble ... in minutes

Now you *can profit* from transistor radio servicing! This amazing new B&K "960" ANALYST gives you *everything* in *one* complete easy-to-use instrument. Makes transistor radio servicing *quick and easy*. Nothing else is needed except the transistor radios themselves waiting to be serviced. Brings you new customers for service, parts, and batteries. Makes this new business *yours*.



EASILY TROUBLE-SHOOT ANY STAGE BY UNIQUE POINT-TO-POINT SIGNAL INJECTION

The ANALYST gives you a complete signal-generating source for point-to-point signal injection. Easily enables you to trouble-shoot any transistor radio—check all circuits stage-by-stage—isolate and pinpoint the exact trouble in minutes.

Supplies modulated signals, with adjustable control, to check r.f., i.f., converter, and detector. Supplies audio signal to check audio driver and audio output. Provides unmodulated signal to test local oscillator. Provides separate audio low-impedance output for signal injection into loudspeaker voice coils to check speaker performance.

BUILT-IN METERED POWER SUPPLY FOR EASY SERVICING

Makes it easy to operate radio under test, while you inject your own signals. Provides from 1 to 12 volts in 1½ volt steps. Supplies all bias taps that may be required.

SIMPLIFIES IN-CIRCUIT TRANSISTOR TEST WITH NEW DYNA-TRACE SINGLE-POINT PROBE

Unique single-point probe needs only the one contact to transistor under test. No longer are three wires required to connect to emitter, base, and collector. Gives fast, positive meter indication. Saves time. Makes trouble-shooting simple and easy.

BUILT-IN VTVM

Includes high-input-impedance vacuum-tube voltmeter, which is so necessary for transistor radio servicing.

TESTS ALL TRANSISTORS OUT-OF-CIRCUIT

Meter has "Good-Bad" scale for *both* leakage and beta. Also has direct-reading Beta scale, calibrated 0-150. Assures quick, accurate test. Also automatically determines whether transistor is NPN or PNP. Meter is protected against accidental overload and burn-out.

Model 960. Net, **$99.95**

Solve Every Service Problem and Profit with a Modern B&K Service Shop. See Your B&K Distributor or Write for Catalog AP21-R

B&K MANUFACTURING CO.

Division of DYNASCAN CORPORATION

1801 W. BELLE PLAINE AVE. • CHICAGO 13, ILL.

Canada: Atlas Radio Corp., 50 Wingold, Toronto 19, Ont.
Export: Empire Exporters, 253 Broadway, New York 7, U.S.A.

least, in a comparison with its cost —is the drive belt. Pressure rollers are usually held by a clip or bolt, but drive belts have a mysterious way of being "threaded" through some of the most intricate mechanical mazes. So I showed him a few little tricks I have learned over the years.

By removing the belt from its associated drive wheels or pulleys, you can pull it up against whatever levers, bars, or wheels prevent it from just slipping off. Frequently, you can see how it can be worked around these and removed without disassembling the machine. If not, at least you have identified the very smallest amount of disassembly which will free the belt and allow a new one to be installed.

There's another way to change defective belts, too. You can buy rubber belt material (such as shown on page 100 of the October, 1962 issue) and make the drive belt yourself. The secret to saving time with this method is to thread the belt into position before bonding the ends together. Be sure to make the belt slightly shorter than the actual distance around the pulleys; then, when you snap it into place, it will be firm and tight.

Miscellaneous Defects

There is little that needs explaining about top-of-deck servicing. With the covers off, everything is plainly visible. I showed my friend how to clean the heads (I had the feeling he was merely humoring me during that portion of the demonstration), check the tracking of the tape, and check head alignment.

I use prerecorded tapes for the last two tests. If the tapes are only slightly out of tracking (especially noticeable on four-track stereo tapes), the head can be raised or lowered by an adjustment provided; in a couple of extreme cases, I've had to alter the guide bars to each side of the head. Head alignment is saved till last; then a head-alignment tape is used to adjust for maximum output. Sometimes tracking and head alignment will interact, so always recheck each adjustment a couple of times whenever you have to make either one.

An occasional complaint will mention excessive clatter in the machine. Instead of wasting a lot of time looking for the noisy part, iso-

Find it and Fix it in ½ the time!

EASILY SOLVES "TOUGH DOGS"... INTERMITTENTS ... ANY TV TROUBLE

B&K MODEL 1076 TELEVISION ANALYST

BLACK & WHITE AND COLOR

By Easy Point-to-Point Signal Injection, You see the Trouble on the TV Screen and Correct it—Twice as Fast and Easy!

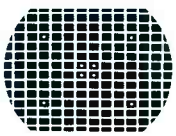
Simplified technique stops lost hours never recovered on **"tough dogs", intermittents,** and **general TV trouble-shooting.** This one instrument, with its complete, accurate diagnosis, enables any serviceman to cut servicing time in half ... service more TV sets in less time ... satisfy more customers ... and make more money.

With the Analyst, you inject your own TV signals at any time, at any point, while you watch the generated test pattern on the picture tube of the television set itself. This makes it quick and easy to *isolate, pinpoint, and correct* TV trouble *in any stage throughout the video, audio, r.f., i.f., sync and sweep sections* of black & white and color television sets—*including intermittents.* No external scope or waveform interpretation is needed. Checks any and all circuits—solves any performance problem. Gives you today's most valuable instrument in TV servicing—*proved by thousands of professional servicemen everywhere.*

Available on Budget Terms. As low as $30.00 down.

Net, $329.95

SIMPLIFIES COLOR TV SERVICING, TOO



Enables you to troubleshoot and signal trace color circuits in color TV sets, or facilitate installation.

Generates white dot, crosshatch and color bar patterns on the TV screen for color TV convergence adjustments.

Generates full color rainbow display and color bar pattern to test color sync circuits, check range of hue control, align color demodulators. Demonstrates to customers correct color values.

Time-Saving, Money-Making Instruments Used by Professional Servicemen Everywhere

Model 960 Transistor Radio Analyst

Model 360 V O Matic Automatic VOM

Model 375 Dynamatic Automatic VTVM

Model 700 Dyna-Quik Tube Tester

Model 440 CRT Rejuvenator Tester

See Your B&K Distributor or Write for Catalog AP21-R

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late the cause of excessive vibration — that's the likely culprit. Smooth out the operation, and clatter will disappear.

The most common cause of vibration is a bent fan on the motor or motors. Unless you're an expert at balancing fans, don't waste time —replace it. To balance a fan is time-consuming at best, and seldom satisfactory.

A worn bearing in a motor can cause an unusual amount of vibration to the machine. Holding the motor tightly will usually damp out the shaking, and identify the fault more conclusively. Again, the best answer is a replacement. Motors usually cost less than the time involved in trying to disassemble the defective one, and some are sealed, anyway.

Vibrations that occur only during recording, playback, or rewinding can be traced to some part associated with driving that particular function. Especially noticeable are worn reel spindles (some of which can be replaced), warped reel carriers, and drive wheels that have been worn eccentric (oval-shaped). A pencil held next to the edge of a suspected part will usually transmit the vibration or wobble to your fingers.

Some hard-to-spot vibrations can be located by rolling a paper into a long, thin cone, holding the large end near your ear, and probing around the mechanism with the tapered end. The cone makes an acoustic amplifier, and the small end forms an isolated pickup device for noise. Beware, however, that you don't locate the *result* of a vibration this way, and overlook the *cause*.

A Friend Indeed

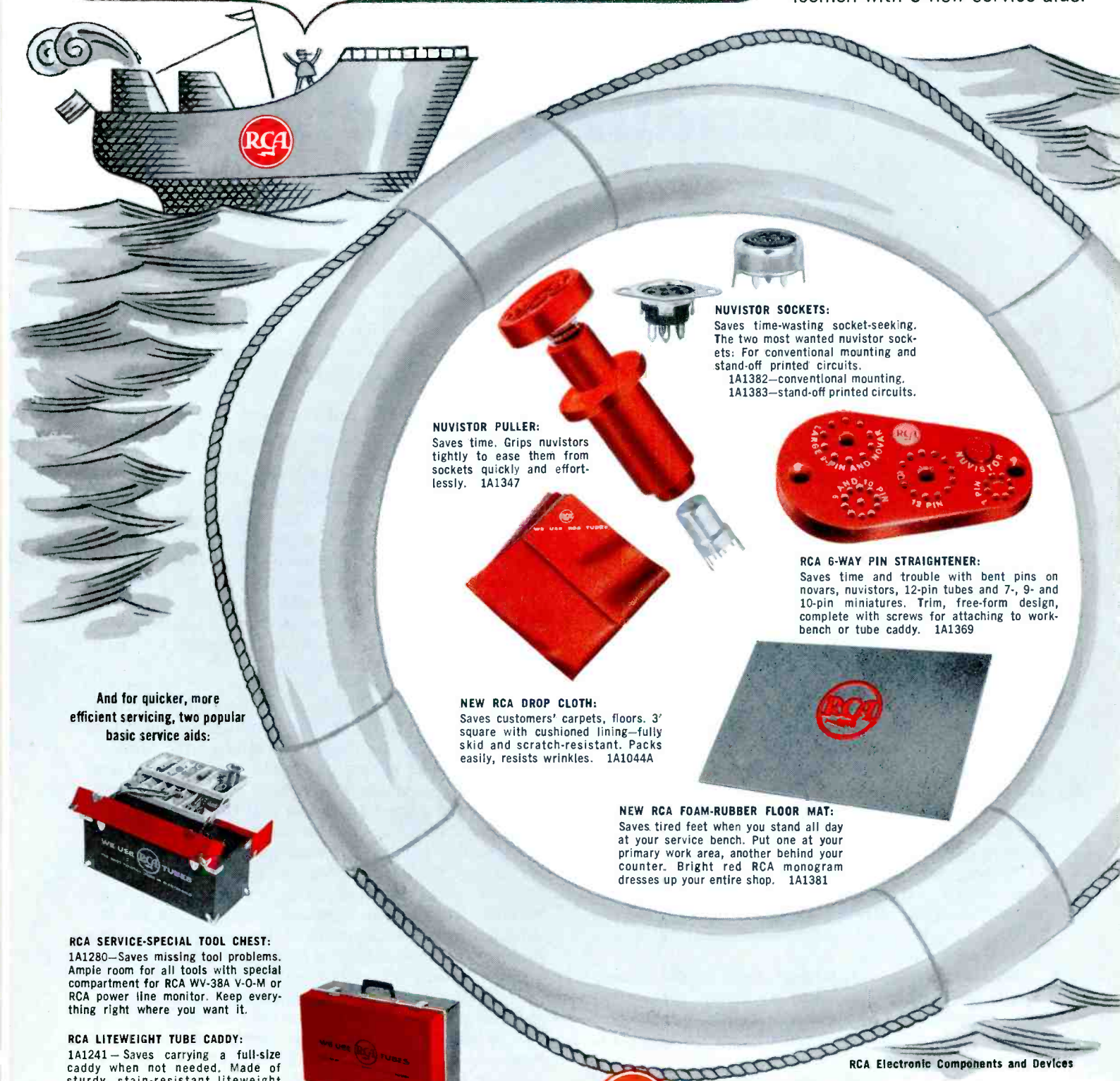
Naturally, this entire demonstration used the recorder my pal had dragged onto my service bench. In the process, we found the cause of his trouble—a defective drive belt. So he got his recorder fixed, at the expense of an hour or so of my time.

But I'm not sorry; after all, he is a good friend of mine, and I myself benefited from a review of just why I do things the way I do. And, if he hadn't dropped by, I'd not have bothered telling *you* about my direct approach to tape-recorder servicing; so I guess we all benefited. ▲

Service Technicians ahoy!

RCA to the rescue!

In electronic servicing, it's the little things that count . . . the minor problems that add up to a major loss of time. Now RCA answers the S-O-S of busy servicemen with 5 new service aids:



NUVISTOR SOCKETS:
Saves time-wasting socket-seeking. The two most wanted nuvistor sockets: For conventional mounting and stand-off printed circuits.
1A1382—conventional mounting.
1A1383—stand-off printed circuits.

NUVISTOR PULLER:
Saves time. Grips nuvistors tightly to ease them from sockets quickly and effortlessly. 1A1347

RCA 6-WAY PIN STRAIGHTENER:
Saves time and trouble with bent pins on novars, nuvistors, 12-pin tubes and 7-, 9- and 10-pin miniatures. Trim, free-form design, complete with screws for attaching to workbench or tube caddy. 1A1369

NEW RCA DROP CLOTH:
Saves customers' carpets, floors. 3' square with cushioned lining—fully skid and scratch-resistant. Packs easily, resists wrinkles. 1A1044A

NEW RCA FOAM-RUBBER FLOOR MAT:
Saves tired feet when you stand all day at your service bench. Put one at your primary work area, another behind your counter. Bright red RCA monogram dresses up your entire shop. 1A1381

And for quicker, more efficient servicing, two popular basic service aids:

RCA SERVICE-SPECIAL TOOL CHEST:
1A1280—Saves missing tool problems. Ample room for all tools with special compartment for RCA WV-38A V-O-M or RCA power line monitor. Keep everything right where you want it.

RCA LITEWEIGHT TUBE CADDY:
1A1241—Saves carrying a full-size caddy when not needed. Made of sturdy, stain-resistant liteweight molded plastic. And it can hold up to 210 receiving tubes at one time.

SEE YOUR PARTICIPATING RCA TUBE DISTRIBUTOR FOR ALL THESE RCA SERVICE AIDS.

RCA Electronic Components and Devices

The Most Trusted Name in Electronics

DOLLAR & SENSE Servicing

by K. V. White

Common Blunders in Handling Credit

Owners of electronics service shops are frequently faced with credit and collection problems forced on them by competitive pressure. A previous article ("Handling Credit On Your Own" in the June 1962 issue) covered these problems in a general way, and made some suggestions specifically designed to aid the service-shop owner in handling these problems more effectively and less expensively. Now, let's look at some actual case histories—credit and collection situations with which television servicemen were actually faced —and see how these problems were handled by the serviceman in question. In each instance, we shall suggest a solution which may well have proved to be more effective, under the existing circumstances.

Missed Payments

The Situation: A television serviceman decided to handle his own financing of a relatively large account for extensive repairs, and arranged with the customer for monthly payments of $17.00 to be made. The customer made several payments as agreed, but then missed one payment. The serviceman was aware of the missed remittance, but was not too concerned, considering the debtor's past credit performance. Payments were resumed the following month, although the missing payment was not made up.

A short time later, two more consecutive payments were missed, and the serviceman became alarmed. He called the debtor, who told him of unexpected financial reverses which would undoubtedly result in several more missed payments.

The Serviceman's Solution: Upset at the gloomy results of his telephone call to the debtor, the serviceman immediately called in a collection agency, who contracted to collect the account at a rate of 33⅓% of the gross amount brought in.

The collection agency then called the debtor and threatened him with garnishment of his wages if the account was not paid in full within five days. The debtor became frantic at this threatened loss of his income, and borrowed sufficient money to pay the account in full.

The television serviceman was very pleased when he received this remittance, less the amount of the collection-agency fee.

In the meantime, the debtor, embittered by his treatment in the hands of the agency and the serviceman, was busy getting revenge in his own way—by loudly criticizing the serviceman's professional capabilities in front of anyone who would listen. These attacks quickly grew into rumors that could not help but draw attention in the serviceman's small community. Some old customers were lost, and the serviceman's income was reduced more than enough to outweigh the gain achieved by forcible collection.

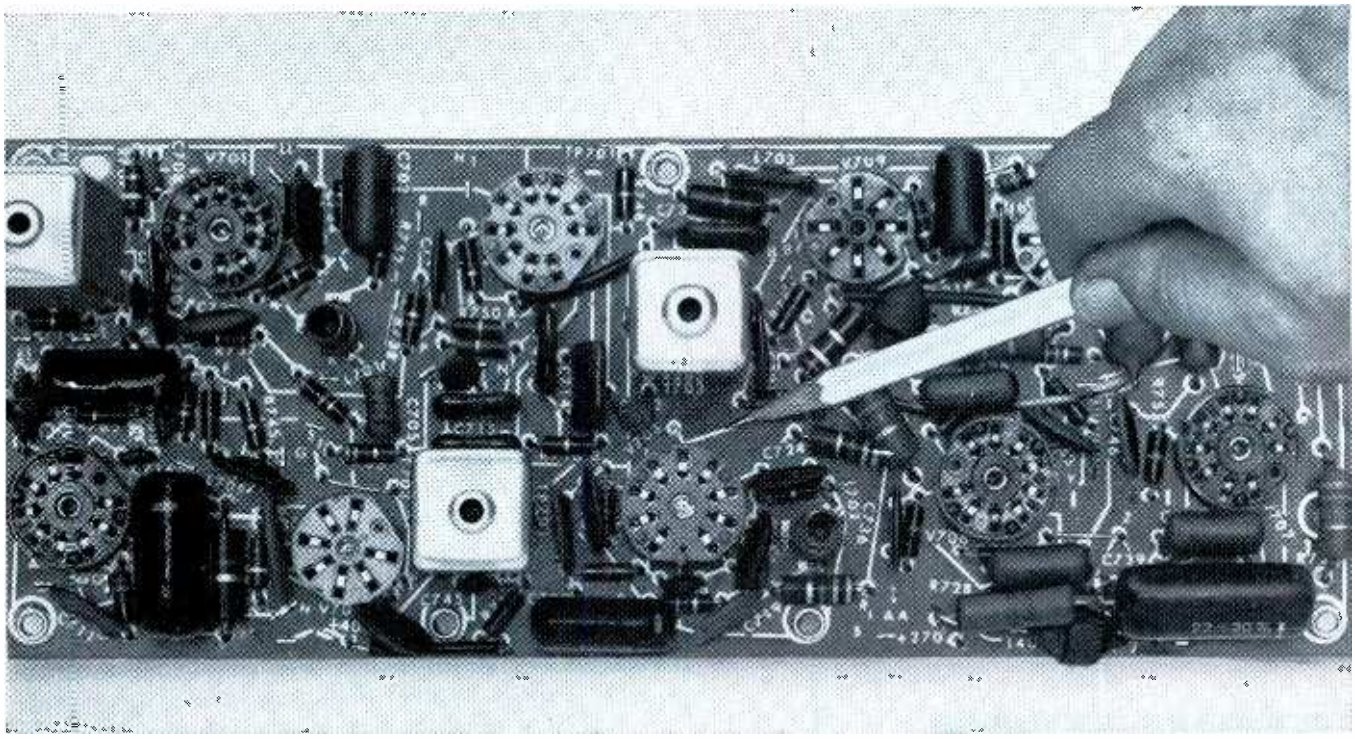
An Alternate Solution: The serviceman, of course, had adequate reasons to be concerned about the account; but he called in the collection agency much too quickly. Actually, he might have averted the need to do so, if he had started questioning the debtor at the time the first payment was missed. This past-due bill, in itself, was a good indication that the customer was in financial difficulty of some kind.

Certainly, after the second missed payment, the serviceman should have been prepared to discuss the situation with the debtor. The outcome of this conversation would have depended, of course, on the individual circumstances involved. However, if collection problems are discussed in a temperate manner, a solution can usually be worked out.

If the financial pinch had appeared to be temporary, reduced payments might have been arranged; or, in case of long-term difficulties, the serviceman could have suggested the possibility of refinancing the account. It is never a good idea to suggest suspending payments

From RCA Victor—another big advance in

Space-Age Sealed Circuitry



RCA Victor Color TV Chroma Circuitry

You can see at a glance how new streamlined "road-mapping" makes servicing faster, easier, surer than ever before

Pictured above is the "new look" in RCA Space Age Sealed Circuitry . . . the new precision-crafted boards that you'll see in *all* 1964 New Vista Color and in most RCA Victor black-and-white television sets for 1964.

This new schematic diagram "road-mapping" consists of *straight white lines* that run *directly* from *point-to-point.* No confusion, no difficult paths. And the extra space gained has been used to make the label markings larger. You can see and trace the circuits at a glance.

Here again RCA Victor has made a vitally important contribution to easier, faster and more accurate servicing. It is part of our continuing research program to offer the utmost in reliability with Space Age Sealed Circuitry.

See Walt Disney's "Wonderful World of Color," Sundays, NBC-TV Network

"HIS MASTER'S VOICE"

RCA The Most Trusted Name in Electronics

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entirely on an account for a period of time. Even if only token payments can be made, they should be accepted, so the debtor is constantly reminded that the account is not yet paid up.

Refinancing is a sensitive subject, and any suggestion along these lines should be made with care. The television serviceman should not put himself in a position of forcing his customer to seek outside financial help. This will only arouse a feeling of resentment in the debtor, since any new loan is bound to create an additional repayment problem. Such resentment will be directed toward the serviceman if he has aggressively insisted on full payment of an account at a faster rate than the debtor can manage.

In any credit situation, *premature* use of an outside agent for collections will only lead to trouble. It should be remembered that a collection agency is likely to threaten a debtor with legal action of some kind, in order to effect a quick turnover of the account. This type of threat frightens most debtors, and may lead to some very undesirable side effects from the standpoint of the television serviceman.

Poor Credit Risk

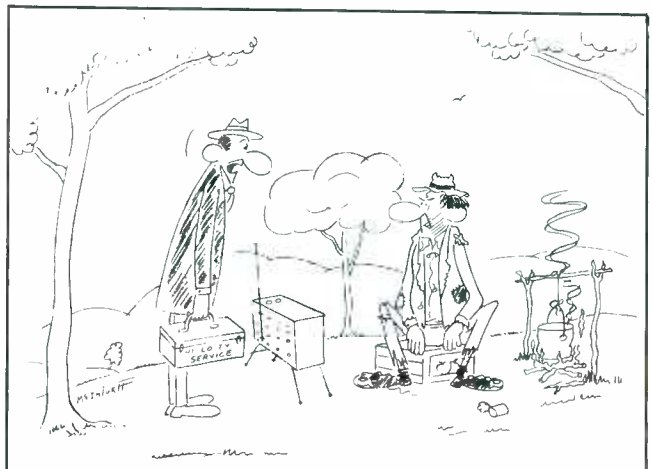
The Situation: A service dealer had ordered and received an advance credit report on a prospective new-set buyer. The report indicated that the person was "slow" in making utility payments, and "very slow" in paying the majority of his other credit obligations. After carefully considering this information, the dealer did not care to carry the account himself, and he knew his financing organization wouldn't accept it.

When the dealer hesitated to extend credit, the customer offered to buy a large console TV, rather than the 19″ model he had been considering.

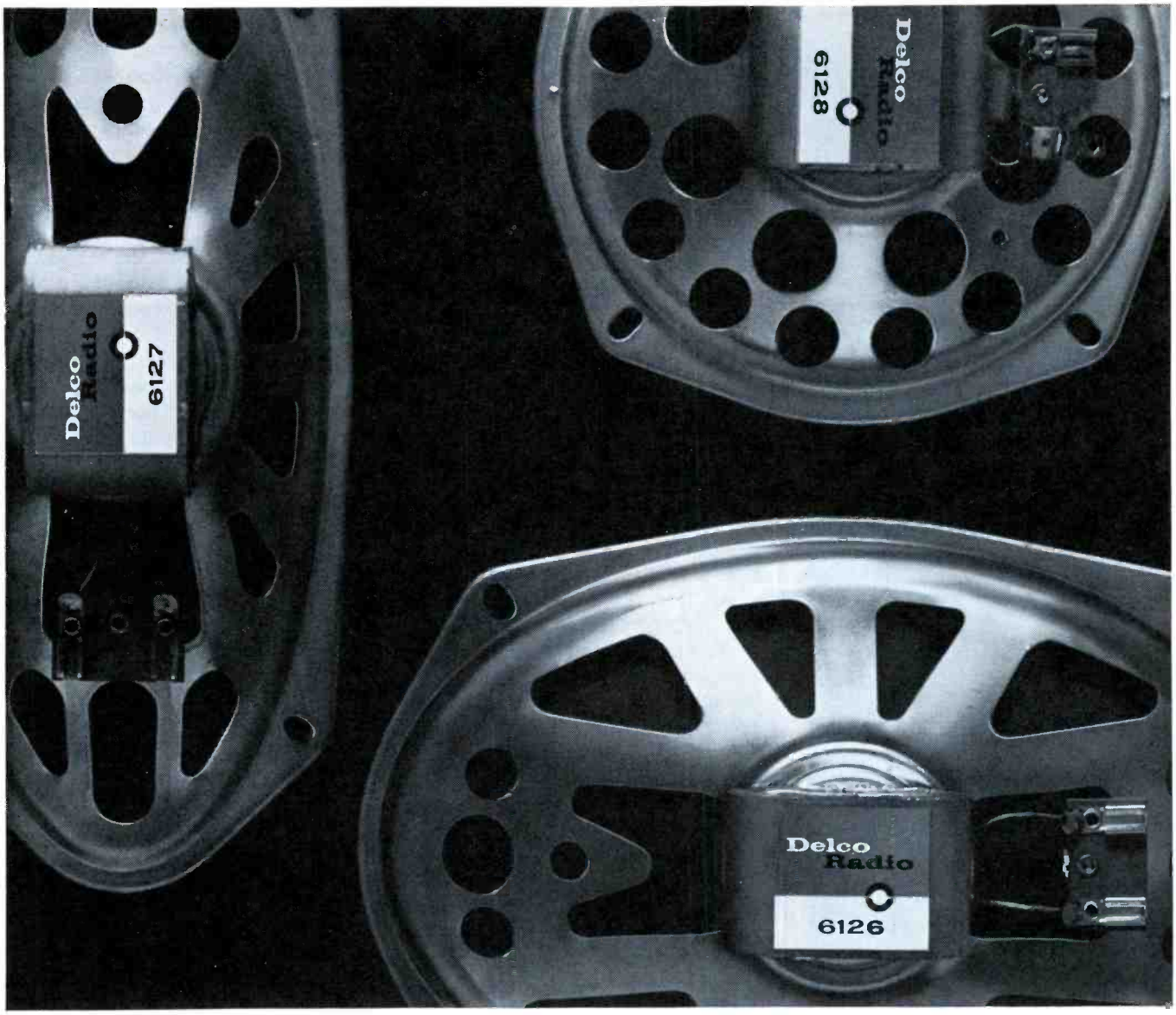
The Service Dealer's Solution: The television dealer could not resist the lure of extra profit, and closed the transaction. However, the account went bad after the first payment was made.

An Alternate Solution: Once an adverse decision has been made on the acceptance of an account, there should be no backing down from that decision if it was based on sound background information.

A poor risk will rarely become a good risk overnight. In this particular case, the serviceman should not have let himself be persuaded to change his mind.



"Considering the circumstances, I think I should ask for several credit references!"



3 SPEAKERS CAN NOW REPLACE 16

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These three new Delco Radio 8-10-ohm replacement speakers permit you to cut 16 numbers from your inventory. They can replace all units in current General Motors cars and many competitive makes. They install easily and quickly, take a "tip jack," "blade," or solder connection. Excellent for home hi-fi and TV sets, too! Speak up for the latest in replacement speakers. Call your United Delco supplier today.

THREE NEW SPEAKERS, ALL WITH SLOTTED MOUNTING HOLES			
Number	Size	Magnet Wt.	Mounting
6126	6 x 9″	1.6 oz.	front/rear
6127	4 x 10″	1.6 oz.	front/rear
6128	6″ round	2.5 oz.	rear-seat

SPECIAL

UNIVERSAL 8-10-OHM
6 x 9″ REAR SPEAKER PACKAGE
Contains all materials necessary for rear-seat speaker installation: Speaker, Grill, Wiring, Switch. Part No. 6122.

Delco Radio Automotive Radio Service Parts and Electro-Mechanical Devices are distributed nationally through **United Delco**

DELCO RADIO, Division of General Motors, Kokomo, Indiana

United Delco

"Skip Tracing"

The Situation: A serviceman extended $157.32 in credit to a customer who subsequently disappeared without a trace. While there was no guarantee that the account could be collected in full even if the customer were found, the entire amount was obviously a dead loss as things stood.

The Serviceman's Solution: Faced with a loss of such proportions, the serviceman panicked. He called in a local collection agency, and was advised they would undertake collection of the account for a fee of 50% of the gross amount collected. Although this fee would obviously wipe out any hope of a profit on the account, the serviceman agreed to the action, on the theory that half a loaf was better than none.

After several months, the debtor was located by the collection agency. By this time, however, several other accounts were involved, and when the debtor was confronted by the agency, he advised them that he had filed a bankruptcy petition. The serviceman eventually received a settlement of $15.73, half of which he owed to the agency.

An Alternate Solution: The serviceman still had the debtor's credit application on file. It contained various items of information that could be used in tracing the debtor —including the name and address of his brother, who lived in a nearby town.

An inexpensive telephone call or telegram to this relative might very well have produced the current address of the debtor. If this lead had been unproductive, the credit application would still have provided other possible contacts—for instance, former employers or neighbors, school or church officials, banks, or loan companies. If the serviceman had taken the initiative in this manner, he might have reached the debtor before the combined pressure of his obligations made him decide to go into bankruptcy. There would then have been at least, a chance of recovering a larger amount.

"Special Deals"

The Situation: A serviceman was approached by the sales representative of an unknown collection agency about the agency's "special plan," which promised to settle difficult accounts at a much lower rate than normal. In due course, the serviceman signed a contract with the agency on the assumption that his past-due accounts would be collected for an agency charge of 5%.

The Serviceman's Solution: Accepting the "special" plan without further investigation, the serviceman turned over to the salesman a number of past-due accounts that had accumulated.

A few weeks later, the serviceman noticed that payments were coming in on these accounts, but in much smaller amounts than he had expected. A further investigation revealed that 33⅓% to 50% of each account was going to the agency, in accordance with the regular rates charged by that organization.

On close reading of the agreement he had signed, the serviceman discovered that only the accounts collected in a three-week period following the date of the contract were subject to the 5% service charge. All others were automatically put into the regular collection channels of the agency, and were then subject to the higher fee.

An Alternate Solution: Since there are unscrupulous firms in the collection-agency business, as well as in any other field, service-shop owners are well advised to check the background of any agency that solicits collections of their delinquent accounts. They might also consider utilizing the services of an attorney; the fee charged is normally comparable to that of an agency. The average debtor will react in the same way to an attorney's efforts as to legal action initiated by a collection agency.

Conclusions

In each of the cases described, the serviceman would have lost a great deal less money if he had taken prompt and aggressive action on his own, rather than letting a credit situation drift from bad to worse. Each shop owner should formulate a collection and credit policy that is effective for his particular situation and area of operation. By thus assuming the major responsibility in these activities, the serviceman will eventually find that he can minimize his loss of income from problem accounts. ▲

Compactrons take the heat off service dealers

More and more of today's newest TV sets are featuring compactrons . . . G.E.'s multifunction electronic devices. This means, eventually, you'll be seeing more compactron circuits in your shop. Therefore, to anticipate some of your questions about compactrons, let's take a look at how compactrons can help take the heat off you and your business:

1. Long waits for repair will be a thing of the past. Simple compactron circuits mean you can locate trouble faster, repair it easier, get sets back to your customers quicker. Fast, efficient service builds repeat business and gets you free word-of-mouth advertising.

Repairs are consistently better because compactrons combine functions having similar life spans. Thus if one section fails, the entire compactron must be replaced—automatically restoring top performance through replacement of the other weakened sections. You save time by not having to check extra tubes and you eliminate the possibility of "weakened ordinary-tubes" not showing up on the tester.

2. No more call backs! When you fix a compactron set, *it stays fixed.* Call backs are virtually eliminated by service-designed compactrons which have a 40% lower operating temperature than ordinary tubes. Cooler operation means greater reliability and gets rid of a difficult trouble spot —peeling and cracking of printed circuits.

3. You make more profit on compactrons because the unit price is higher. Replacing a compactron is like replacing 2 or 3 ordinary tubes. Simpler compactron circuits, plug-in replacement, and fewer tubes to check, let you service more sets in any given time. Employees become more efficient, and need less training.

Multifunction design means that eventually you can substantially reduce your tube inventory. This gives you more "free" operating capital, more shelf space, plus less capital investment . . . hence a greater profit per dollar invested.

Remember, you'll be seeing more compactrons in the future . . . They'll mean easier servicing and happier customers for you.

Progress Is Our Most Important Product

GENERAL ELECTRIC

DISTRIBUTOR SALES

Guide to PHONO-TAPE Charges

This chart is meant to be used only as a general guide for determining the proper fees to charge for phonograph and tape recorder servicing. Prices shown here are the average of those charged by a number of different shops.

The exact figures set by a specific shop, or for a given piece of equipment, are affected by several variables. For example, shops that specialize in servicing phono and tape equipment are often able to do profitable work at lower rates than shops having only occasional activity in this field. In both types of businesses, the service charge for a foreign-made unit (especially a tape recorder) is frequently quoted two or three dollars higher than for a domestic model, because the imported sets are considered harder to service. Besides having unfamiliar mechanical and circuit features, they sometimes take twice as long just to disassemble.

Tape recorders of the "toy" type, and record players listed in the "phono with amplifier" category of the chart, command a lower service charge for at least three reasons: low original cost, simple design, and noncritical performance standards. Quite a few shops do not accept toy tape recorders for servicing, because they have found no way to do so at a profit. On the other end of the price scale among tape recorders, the professional-type machines costing several hundred dollars are serviced mainly by specialists who do a meticulous job and charge accordingly.

Some shops charge a flat rate for each phono or tape job, while others favor an hourly rate subject to a minimum charge. Nearly all those we have contacted do not exceed a certain maximum fee, even when they encounter a time-consuming "dog"; but the maximum charge is on a sliding scale, based on the complexity of the equipment. Note the prevalence of higher charges for tape recorders than for record changers. ▲

	CHANGER MECHANISM	CHANGER WITH AMPLIFIER	PHONO WITH AMPLIFIER	TAPE RECORDER		
				Toy	Home	Pro
HOME SERVICE CALL	SAME AS USUAL TV SERVICE CHARGE					
BENCH SERVICE — MIN.	$5.00	$5.00	$4.00	$4.00	$8.50	$12.50
BENCH SERVICE — MAX.	$10.00	$12.50	$7.50	$7.50	$16.00	———
FLAT RATE FOR OVERHAUL (LUB, ADJ, ETC.)	$7.50	$7.50	$4.00	$4.00	$8.50	$12.50
BENCH SERVICE— HOURLY RATE	$7.50 FOR ALL TYPES OF EQUIPMENT					

Centralab

BRAND NEW
CENTRALAB
FASTATCH II®
FRK-200 KIT WITH
EXACT REPLACEMENT SHAFTS

Makes Control Replacement A SNAP!

- Centralab's new FRK-200 kit gives you the most convenient, most versatile, and simplest system for control replacement.
- Since it includes 13 sizes of exact replacement shafts, shaft cutting is eliminated on *all* the popular dual concentric controls and on almost 60% of all dual controls.
- The Fastatch II® Control System is a snap to use. Single and dual concentrics snap together without tools! Shafts plug in and are permanently locked. Assembled units can't loosen—shafts can't pull out.

JUST CHECK THESE EXCLUSIVE FEATURES:

1. Just one control system for dual concentric or single controls.
2. Universal terminals.
3. Plug-in, permanently locking shafts.
4. Rotary or push-pull (snap-on) line switches attach to both front and rear controls.

The FRK-200 kit is contained in two stacking Equipto steel cabinets with plenty of extra space for expansion. *All* your control needs, including push-pull, are at your finger tips.

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NOTES ON TEST EQUIPMENT

by Forest H. Belt

Down With Transistor Troubles

To help in the never-ending battle of serviceman versus transistor radio, here is another compact troubleshooting aid —the Model 36-568 Transistor Radio Troubleshooter (Fig. 1) by GC Electronics. This multi-purpose instrument is housed in a metal carrying case for portability.

Specifications are:

1. *Power Required—117 volts AC; 60 cps.*
2. *Tests — Checks transistor Iceo and gain; checks rectifier leakage; measures current and voltage, up to 100 ma and 24 volts, respectively; tests radios by signal injection.*
3. *Outputs—Power supply can furnish maximum of 24 volts DC at current levels up to 50 ma, or maximum of 18 volts at 100 ma, metered by panel meter; 1.5-volt DC tap; signal generator tunable from approximately 450 cps to 1200 cps, with output (an essentially square waveform with shape variable by* VOLUME *control) about 1 volt peak to peak, although rms value varies with waveshape.*
4. *Panel Meter—Face size 2½"; sensitivity 1 ma, 1000-ohm movement; 0 to 24 voltage scale, 0 to 100 ma current scale, 0 to 100 gain scale, and three "good-bad" leakage scales.*
5. *Controls and Terminals — Rotary function-selector switch;* VOLTS ADJ *and* VOLUME *potentiometers;* POWER *and* LO-HI *(gain) slide switches;* GAIN *push button; transistor socket and three test terminals; three voltage-output terminals.*
6. *Size, Weight, Price—3" x 9¼" x 9" overall, with cover in place; approximately 4 lbs; $49.50.*

The Model 36-568 contains most of the instruments needed to trace the majority of transistor-radio troubles. Included are the means for isolating the defective stage in a faulty set, testing the transistor or diode involved, measuring voltages and currents in and around the circuit, and powering the receiver during all these tests.

Of course, the instrument itself is transistorized, incorporating two transistors in the multivibrator circuit (Fig. 2) that serves as the signal generator. The VOLUME control affects both the frequency and the waveshape of the multivibrator signal. The frequency is lowest at minimum feedback (slider near the 100K resistor), since the resistance of the control is in the feedback circuit and the time constant is longest. Minimum frequency of the unit we tested is in the neighborhood of 450 cps, but this would probably vary with different transistor characteristics. In addition, the 1-volt peak-to-peak waveform is more nearly a sine wave at minimum feedback, and has the least rms (effective) value.

As feedback is increased, the feedback capacitor is nearer to the base of X1, and the frequency rises — reaching 1200 cps in the unit we checked. In addition, the waveshape takes on the sharp-cornered characteristic of square-wave pulses. The consequent increase in rms value (even though the peak-to-peak value remains the same) results in more signal strength for troubleshooting. The increase in effective signal appears in the transistor receiver as greater volume—thus the label "VOLUME" on the Model 36-568 ouput control.

A pair of 1N536 silicon diodes supply

Fig. 1. Compact transistor-testing instrument is contained in metal case.

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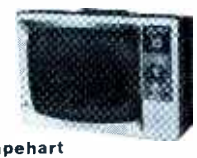
RCA Victor 213G235RV

Emerson C-2001A

AMC D1863A

Electrohome Cameo



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DC power for the instrument. A small power transformer with center-tapped secondary forms the voltage source for a full-wave rectifier circuit, which develops an output voltage of nearly 30 volts DC. Filtered by a 100-mfd electrolytic capacitor, the DC voltage is utilized for the internal signal generator as well as for powering the transistor receiver to be tested.

In using the Model 36-568 for troubleshooting transistor radios in our lab, we found that several sets required more filtering and decoupling than provided by the instrument. Motorboating is not an uncommon occurrence when these receivers are being serviced, because they depend on the low internal impedance of their power supply (fresh batteries) to prevent interstage coupling. We found that by adding a 1000-mfd electrolytic capacitor across the output terminals of the Model 36-568 we could reduce the "apparent" internal impedance of the instrument sufficiently to eliminate most of this tendency to regeneration.

In some sets (again those which contained little filtering of their own), a distinct hum was heard. To be sure, the hum was not enough to seriously hamper servicing, but in troubleshooting certain types of audio faults it was necessary to take this noise into consideration. For example, we've developed scope techniques to speed transistor servicing in some circuits; while applying these, we found noticeable hum on scope traces and had to consider it when interpreting scope patterns. Connecting the 1000-mfd capacitor across the output leads again proved a workable solution.

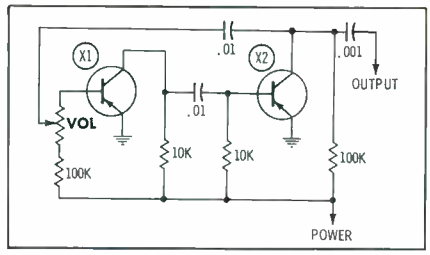


Fig. 2. Multivibrator is used to form audio square-wave pulses for injection.

One of the most useful capabilities of the instrument proved to be the testing of transistors (Fig. 3). Qualitative tests of individual transistors are simple and informative. The quick test for shorts or Iceo leakage is a time-saving way to find faulty transistors, since this particular defect is one of the most common in transistors. If Iceo leakage becomes very significant, a transistor cannot operate normally; therefore, the Iceo test is most useful for determining whether a transistor will function at all.

The gain test goes a step further. If the Iceo test shows the leakage is not too great, the gain test then tells how efficiently the transistor will amplify. For this test, a fixed bias voltage is applied to the base, and the resultant collector current is measured by the panel meter. An important point to remember with this type of tester is that gain tests should be correlated with the Iceo leakage test. That is, if a transistor indicates a high collector-emitter leakage, the gain reading will be correspondingly higher than for a transistor with little or no Iceo leakage. Thus, a transistor with an Iceo of 5 ma and a gain reading of 60 on the panel meter might be better than one with an Iceo reading of 10 and a gain of 70. It is well to keep this in mind when you're matching transistors for output stages and similar uses where comparative gain is important.

Since the test bias applied to every transistor is the same (except for power transistors, which are tested with a

Fig. 3. Setting one switch and pressing pushbutton make up testing procedure.

slightly higher bias), all gain readings of the Model 36-568 are relative rather than actual. To make these readings more meaningful for individual transistors, a booklet included with the tester contains relative readings for a large number of the more popular transistors. With this chart, you can determine quickly and easily if the gain of any particular transistor is normal for its type, or if its Iceo is greater than it should be.

For further information, circle 102 on the literature card.

Tube Testing—Deluxe Style

The tube tester shown in Fig. 4—the Hickok Model 752A—is one of the more complete tube-testing instruments presently available. It is designed to fulfill the testing needs of the diversified servicing shop—the service business that engages in industrial and communications servicing as well as radio and television repair.

Specifications are:

1. *Power Required—105-125 volts AC; 60 cps; 40 to 70 watts, depending on tests being performed.*
2. *Tubes Tested—All receiving, transmitting, and industrial types, including voltage regulators, 5-pin nuvistors, and subminiature types; special adapters available for CRT's, lighthouse tubes, pencil types, and a few other uncommon types; roll chart lists more than 1200 types, and instrument design permits setting up to test all others; each section of dual-purpose tubes tested separately.*
3. *Tests Performed — Mutual conductance in ranges from 0 to 1500, 3000, 6000, 15,000 and 30,000 micromhos; interelement leakage, sensitive to 10 megs; life test, a check of cathode activity under reduced filament temperature; emission test for rectifiers and diodes; gas test.*
4. *Panel Meter—Face size 4½"; lighted; sensitivity 280 ua, 645-ohm movement; leakage scale, 0 to 10 megs; 0 to 1500 micromhos; voltage-regulator scales, 0 to 200 volts and 0 to 100 ma.*
5. *Controls and Terminals—Ten test push buttons; rotary selector switches labeled* FILAMENT *(voltage),* FILAMENT *(heater pin),* FILAMENT *(grounded pin),* GRID A, GRID B, PLATE,

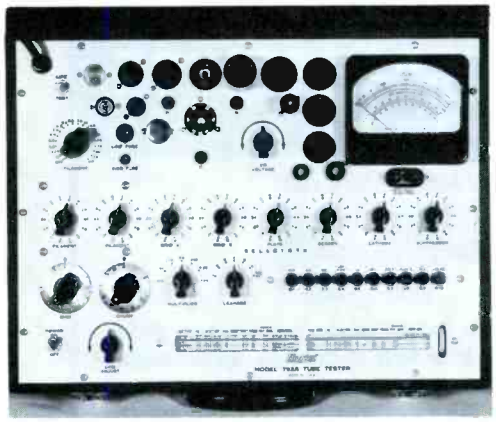


Fig. 4. Elaborate tube tester can check communications and industrial tubes.

SCREEN, CATHODE, SUPPRESSOR, MULTIPLIER, *and* LEAKAGE; LINE ADJUST, VR VOLTAGE, BIAS, *and* SHUNT *potentiometers;* POWER *toggle switch;* LINE *push button;* SELF-BIAS RESISTOR *terminals; 4-pin, 5-pin, 6-pin, 7-pin, octal, loktal, compactron, novar, noval and 10-pin miniature (combined), 7-pin miniature, 7-pin in-line subminiature, 8-pin subminiature, acorn, and nuvistor tube sockets; three pin jacks for plate, grid, and cathode caps; 7-pin and 9-pin straighteners; lighted roll chart.*

6. *Size, Weight, Price—7½" x 18⅜" x 16¾"; 25 lbs; $355.00.*

An important consideration in any tube tester is the completeness of its tests. Tubes operate under so many different conditions that tests are sometimes inconclusive unless they are made under conditions similar to those of actual use. The Model 752A closely duplicates operating conditions, to give very accurate tests. Its settings are arranged so tests can be completed quickly. True, more time is required than with quick-check testers, but in industrial and communications work (and often in radio-TV receiver servicing) the extra time taken in precisely evaluating tubes for critical circuits is well spent. The Model 752A has been designed with complete testing in mind—thus the extra provisions for separate and distinctive tests.

Another feature of the 752A that deserves consideration is the convenience of setting up your own test data for tubes that don't have tester settings listed. (See "Develop Your Own Tube-Test Data" in the April, 1962 issue.) Once characteristics have been published for a new tube type, you can easily set up the Model 752A to evaluate the tube accurately.

The instruction manual with the instrument indicates what voltages are connected to which elements of a particular tube socket during each test. For example, you can choose either of two plate voltages—75 or 150 volts DC; you can select either 56 or 130 volts DC for the screen; grid bias can be set at any value from zero to –40 volts DC, or a resistor can be connected (at terminals on the panel) to operate the tube with self-bias; you can select any one of 18 filament voltages from .6 volts through 117 volts AC; and you can choose a signal voltage that best fits the tube being tested—.25, .5, 1.25, or 4.5 volts AC. These selections permit a wide latitude of test conditions, to suit almost any operating situation.

Fig. 5. Typical VHF communications RF amplifier shows excellent gain in test.

Fig. 5 shows a typical communications tube being tested in the Model 752A. Following each step as we check this 6146 VHF amplifier will give you some idea of the thoroughness with which a tube can be evaluated. Locating the 6146 on the roll chart, we set the selector switches according to the listing: Filament selector set for 6.3 volts; pin-selector switches set at pins 7 and 2 for filament, 5 for grid A, 0 for grid B (there is none in the 6146), 0 for the plate (a plate-cap connection must be used), 3 for screen, 1 for cathode, and 8 for suppressor; bias control at 12; multiplier switch set for X10 to obtain the correct Gm range on the panel meter; and plate-cap lead connected.

With the tube in the socket, our first step was to check for leakage by rotating the LEAKAGE test switch. Finding nearly 600K at positions 1 and 2 of the switch, we consulted a chart in the instruction manual and identified the fault as cathode-heater leakage. Since the transmitter circuit from which this tube was taken operates with the cathode grounded, we decided this fault would not adversely affect operation, so we proceeded with further tests.

Next, with the LEAKAGE switch at the "Tube Test" position, we depressed test switch S5 (as directed by the roll chart) and read the mutual conductance (Gm) on the 1500-micromho scale of the panel meter. The reading was 750; since we were using the X10 setting, the actual

Gm reading was 7500 micromhos.

The life test was next. This evaluation consists primarily of comparing an arbitrary Gm reading with a second reading taken with the heater voltage significantly reduced. The multiplier switch was set to the "Shunt" position, S5 was depressed, and the SHUNT potentiometer was adjusted for a reading of exactly 1000 on the panel meter (two-thirds of full scale). Then, with S5 held down, the LIFE TEST push button was depressed. If the meter reading had dropped to less than half scale, this would have indicated a limited life expectancy for the tube (because of cathode deterioration). In the 6146 we tested, the reduction was only a couple of scale divisions—an insignificant amount. Thus, the life expectancy of the tube (as far as cathode emission is concerned) was proven quite satisfactory.

Lastly, we checked for gas content. Setting the scale MULTIPLIER switch for X2, we depressed GAS-1 push button S6, and adjusted the BIAS control for a reading of 100 on the Gm scale. Holding S6 down, we depressed GAS-2 push button S7 and watched the meter pointer. Excessive gas is shown by an upward deflection of the pointer—two or more scale divisions. The 6146 showed hardly a flicker of the pointer, indicating it was completely free of gas.

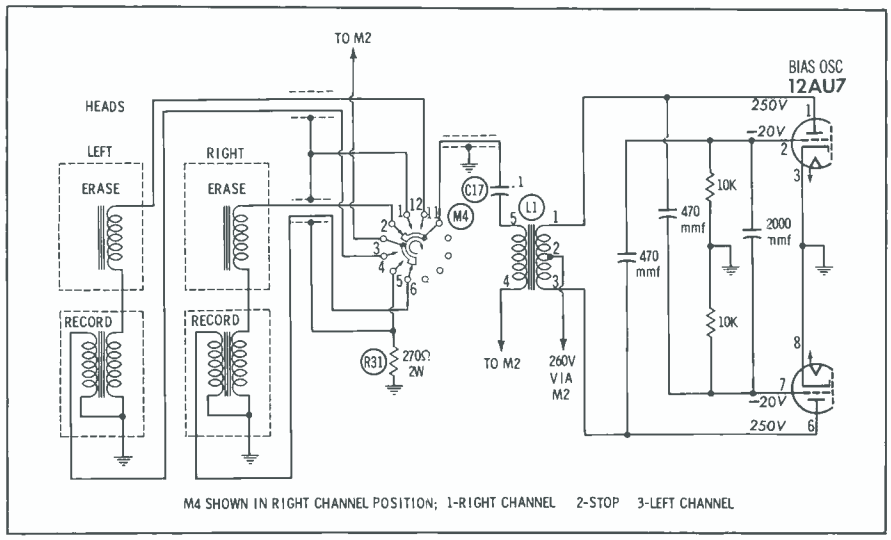
Later, we ran the Model 752A through our "gamut" of known defective tube types, noting how the instrument reacted to the various faults represented in this collection of bad tubes. Mutual conductance readings were similar to those indicated by our lab tester, and leakage indications were dependable. A few borderline gas cases slipped by, although in every one the amount of gas was less than will usually cause trouble except in very critical circuits. For example, one of our prize "gassers" is a tube that draws only about 5 ua of grid current, but in certain IF stages causes unusual picture-pulling symptoms. This one has been missed by most service-type testers we've had in our lab, except for those with extremely sensitive grid-emission tests. With this one exception, the Model 752A went through our series of "curve-balls" without an error.

For further information, circle 103 on the literature card. ▲

Fig. 6. Large lamp illuminates the roll chart. Note 5Y3 and 83 rectifier tubes.

THE TROUBLESHOOTER

answers your service problems



If I Could Erase . . .

After replacing a worn head in a Webcor Model 2812 tape recorder (PHOTOFACT Folder 393-12), I noticed the machine's inability to erase previously recorded material. A new signal is simply recorded on top of anything that is already on the tape. This trouble is present when the tape is traveling either to the left or to the right, even though separate record and erase heads are provided for each direction of tape movement.

I've carefully checked all voltages and resistances, replaced all the tubes, and checked all the wiring around the erase and record heads; but I can find nothing amiss. A test signal from a generator can be fed through either set of heads to the amplifier, and comes out loud and clear. Going by this evidence, and considering that both tape tracks are affected, I suspect trouble in the bias-and-erase oscillator; however, I need help in getting on the right track toward a solution to the problem.

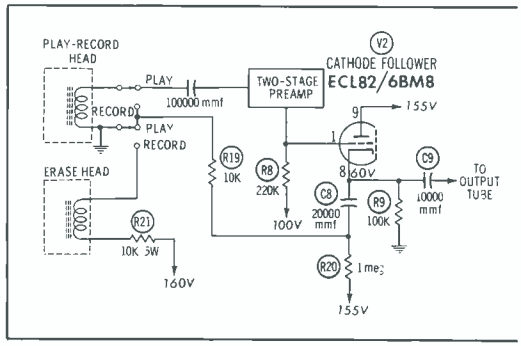
ED DURKIN
New York, N.Y.

I agree with your diagnosis: now let's see what might be wrong with the oscillator. This circuit is a cross-coupled multivibrator that feeds a 60-kc signal via L1 and head switch M4 to the erase heads. To troubleshoot this section, record-playback switch M2 must be in the "record" position; otherwise, no B+ will be applied to the multivibrator plates. Failure of M2 to make proper contact could disable the multivibrator. Various other troubles within this circuit could also cause it to stop oscillating. To make a quick check of its operation, use your scope to look for a fairly strong 60-kc waveform at terminal 5 of L1. If there is no signal here, voltage and resistance readings in the multivibrator should pinpoint the cause.

Should you find a waveform at L1, trace toward the heads with the scope to find where the signal is being lost. An open C17, or poor contact in M4, would be the most probable troubles. I doubt that you'll find a defective head, because this fault would affect recording and playback as well as erasure, and it would be a rare occurrence for both sets of heads to give trouble at once.

Distorted Recordings

I'm having trouble with severe distortion in a Recordio Model 804 tape recorder (PHOTOFACT Folder 548-12). The difficulty seems to be in making the recordings, since there is no distortion when I play back tapes that were made before the set became defective. Voltages all check okay except for a few slight discrepancies in the area of cathode follower V2. I've changed V2, C8, C9, B+ filter capacitor C1, R8, R9, R19,



R20, and R21 with no effect. If I reduce the value of R20 from 1 meg to 220K, most of the distortion is eliminated, but the volume becomes too weak to be satisfactory. I've tried using a different microphone, and monitoring the output from the amplifier while recording—still no clues.

JIM KEY

Farmington, Mo.

A recording problem that doesn't impair the playback function is most likely due to trouble in the erase-head circuit—either a defective head or an external fault that causes incorrect current through the head. This recorder uses a simple DC input to magnetize the head for erasing and biasing the tape; therefore, checking the erase circuit is a simple matter of tracing voltages or resistances through R21, the head, and M2 with the machine in "record" mode—also substituting for the head, if necessary.

If the erase circuit is in good shape, consider the possibility of the play-record head being overloaded by strong signals fed to it in the "record" position. To follow up on this idea, check the condition of the play-record head, and carefully examine the circuit of V1.

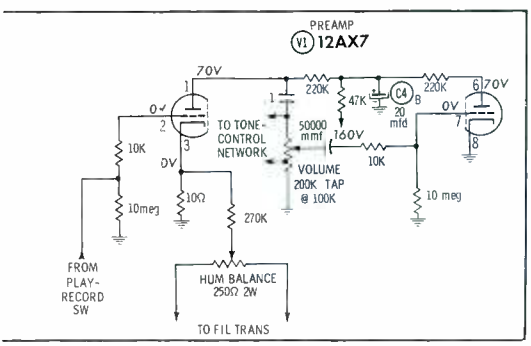
Hum on Playback

A Wollensak Model T-1515 tape recorder (PHOTOFACT Folder 400-13) has me at bay. In the playback position only, it has a 60-cycle hum that appears to be originating in the first section of preamp tube V1. To eliminate possible hum pickup from the heads and motor, I've disconnected these components so the unit can operate as a straight amplifier.

When pin 7 of V1 is grounded, the hum disappears; when I ground pin 2, it's still present at low volume. The scope shows a hum waveform at the plate (pin 1). I've changed C4B, and have scoped the B+ line to make sure it is free of abnormal ripple. Shorting the cathode of V1A (pin 3) to ground only increases the hum level.

When the unit was brought in, the preamp was acting as a multivibrator whose output frequency increased as the volume was turned up. On the bench, I can't induce this condition now. Wires and components have been rerouted, and connections resoldered, without making any difference. I went over the play-record switch and found no open contacts.

The hum increases as I bring my hand close to the chassis, but decreases when



any metal part is touched; can you explain this?

RAYMOND BARNETT

Hazleton, Pa.

I think you'll find a poor ground connection somewhere in the preamp stage, or at the play-record switch; this trouble has occurred a number of times in these particular recorders.

Double-check to make sure the hum-balance control is operative. Also, to eliminate stray pickup of radiated hum, be sure the shield cover is in place over the input jack underneath the amplifier chassis.

Heat Prostration

An Elizabethan Model LZ49 tape recorder, made in England, operates normally for about 45 minutes; then a loud grinding sound comes from inside the machine, and the takeup reel stops turning. In addition, the "start" and "fast forward" keys do not function. Since I noticed that the unit runs quite hot, I checked the temperature by placing a thermometer on the deck; the reading is 100° F when the trouble appears. If I turn off the machine and let it cool down for an hour or so, it plays normally again until the heat reaches the critical point.

AL RAMO

Long Island City, N.Y.

An operating temperature of 100° is not the least bit abnormal for a continuously operating tape recorder, but this unit is apparently suffering from a mechanical fault that is aggravated by the heat. Expansion of poorly fitted parts in the drive mechanism may bring on the condition, or the drive surfaces may be contaminated by grease or oil that gets slippery enough to destroy traction at high temperatures. Carefully inspect the mechanism to see if you can find any points where binding or slippage is likely to occur; while you're at it, clean the drive surfaces with alcohol.

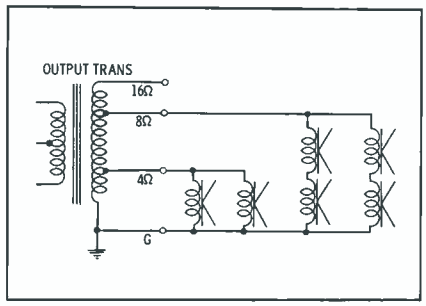
Loads of Speakers

I have a 50-watt audio power amplifier, and want to connect six 8-ohm speakers to it in such a manner that the volume can be individually controlled at each speaker. (Six 8-ohm level controls are on hand for this purpose.) Three of the speakers will be 50' away from the amplifier, and the remaining three will be approximately 30' away. I can use No. 12 or No. 14 wire if necessary.

DUDLEY S. WEAVER

Kent, Ohio

The feedback used in this amplifier should be sufficient to let you make the



hookup shown in the schematic without unduly affecting amplifier response. Connect two of the speakers in series, and two others in series; then parallel the two strings and connect them to the 8-ohm tap. Wire the remaining two speakers in parallel, and connect them to the 4-ohm tap. Assuming the level controls are of the pad type, simply hook them at each speaker so a constant impedance is presented to the amplifier—not to the speaker. (If they are of the type that present constant impedance in both directions, there is no problem.)

As you are probably aware, the amplifier will furnish only about 8 watts to each speaker, even if you have a good impedance match. However, 8 watts may be sufficient for the purpose you have in mind.

Recorder Out of Order

In my shop I have a Tapemaster Model PT-121 tape recorder (PHOTOFACT Folder 186-14) that will not operate. I have tried a new head, replaced all tubes, checked all electrolytics, and made sure the B+ voltage is normal. Other voltages agree with those on the schematic except for the following: Plate of preamp stage reads 200 volts—should be 140 volts in record mode and 170 volts in playback. Both grids of bias-erase oscillator (a multivibrator) read –10 volts—should be –60.

My prerecorded tapes will not work on this machine, possibly because the tape moves in the opposite direction from that of most other recorders. I checked the unit with a mike and an external amplifier, and it passed the signal, but its performance was only fair.

EMORY A. FERGUSON
Snohomish, Wash.

The high plate voltage on the preamp may mean the tube is not conducting hard enough; the reason could be a bad socket connection, an open or high-value cathode resistor, or low filament voltage. Such a fault would readily explain the poor performance of the recorder.

The low grid voltages on the multivibrator might mean trouble, but I rather doubt this. Did you, by any chance, use a VOM instead of a VTVM? It would load either multivibrator-grid circuit and falsify the readings.

You should be able to use a prerecorded tape for testing, even though the tracks would be run backwards on the Tapemaster machine. However, it would be easier at first to use a signal-injection technique for isolating the defective stage or section, just as in any other audio amplifier.

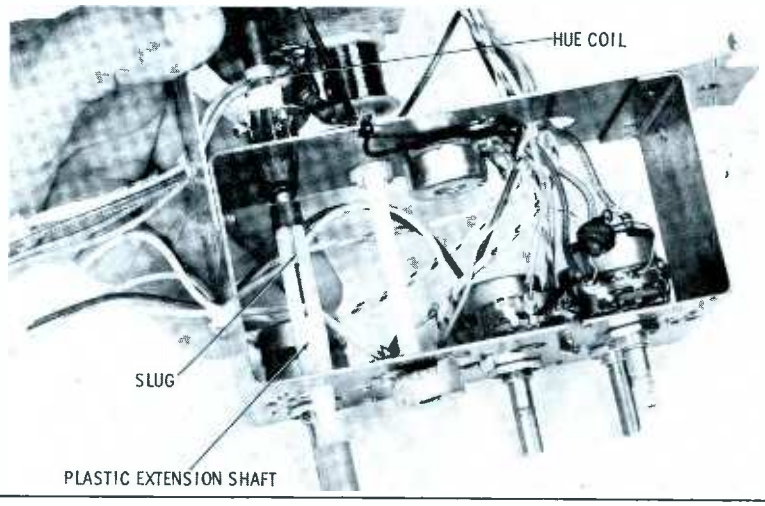
Unchanging Volume

One of my customers dropped his Westinghouse Chassis V-2397A transistor radio (PHOTOFACT Folder 477-14), breaking several connections. After repairing the breaks, I found the volume control had no effect; the output remains at maximum. I've checked the ground connection of the control, and have removed and disassembled it—finding no trouble

COLOR COUNTERMEASURES

Symptoms and tips from actual shop experience

Chassis: Zenith 27KC20, 29JC20
Symptoms: Wrong colors; hue control inoperative.
Tip: This trouble with reception of color programs is usually the result of misadjustment by the customer. The reproduced hues on the face of the picture tube will appear predominantly blue and green—with very little red. When this defect appears, connect the color-bar generator to the antenna terminals, and tune in the generator signal. Then try rotating the hue slug (with the knob removed), while watching the screen for the correct color display from the generator. In some cases, you'll find the slug to be jammed because the customer has turned it too far into the coil form. If this has happened, it will be necessary to gain access to the coil slug itself, before you can loosen it to a point of turning freely. In either case, position the slug to obtain the proper color pattern on the CRT. As a final step, replace the operating knob (a stop-tab type, depicted in the photo) and be sure to show your customer how to prevent a recurrence.

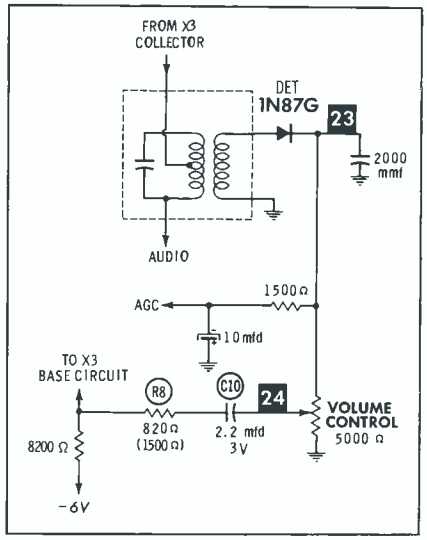


there. Checking components and voltages in the related circuits has not led me any closer to a solution.

EDWARD E. THORNLEY
Georgetown, S. C.

Closely inspect the printed wiring and see if you have a solder bridge or other leakage path between the conductors identified by CIRCUITRACE *numbers 23 and 24. These conductors, which respectively go to the top side and the arm of the volume control, run very close to each other for a fair distance—and this particular area of the board is quite vulnerable to damage.*

Of course, there is also a possibility of an incorrectly connected component such as C10 or R8. If no obvious faults can be found, try replacing transistor X3, which operates as a reflex amplifier for both the IF and audio signals.



Latest Jackson Tube Test Data

Model 648					Model 658						
Tube Type	Fil.	D.	E.	Plate Test	Sec.	Circuit Heater	H-K	P-G	Plate	Grid Test	Heater Current
2DZ4	2.5	A235	A17	38XY	T	2.5L	125	a37	12S	15WY·	A8.5M Z600
2GW5	2.5	A235	A17	16XZ	T	2.5J	125	a37	16R	7WY·	A8.5L Z600
3DZ4	3.0	A235	A17	38XY	T	3.0P	125	a37	12S	15WY·	A8.5F Z450
6HA5	6.3	A234	AC15	30V	T	6.4J	124	ac35	18R	7WY·	
6JB6◆	6.3	1237	AB459	17W	P	6.4N	1237	ab450	22R	80VY·	
Nor. -S switch in S position											

SUPPLEMENT TO LATEST ROLL CHART 648-27 658-6

Intercoms

(Continued from page 35)

supplies signals to all of the slave stations, the paging announcement will be heard at each station. (Of course, the switch that closes the microphone circuit also opens the program circuit so they won't both be on at the same time.)

Locating the Stations

To derive the most benefit from today's versatile intercom systems, initial planning by the technician is the key to customer satisfaction. It is first necessary to evaluate the user's needs and also to inspect each one of the proposed station locations to determine maximum accessibility and minimum background noise. (A high noise level can seriously deteriorate communications, even when handsets are used.)

Although it is best to position the intercom near the operator and in a quiet location, it is sometimes difficult to do so. In his normal activity, the operator may at times be a considerable distance from the intercom. Also, if the station serves several people, it must be adequate to cover the area of activity concerned.

Even if the area served is noisy, it may be possible to use a conventional speaker-style intercom station. Simply employing a highly efficient type of speaker will often make incoming calls audible over a sufficient distance. If additional power input to a speaker is needed, booster amplifiers are available.

System Wiring

Proper wiring is a very important consideration in maintaining good intercom sound levels. Overall line resistances of several ohms can attenuate sound levels seriously in low-impedance systems; therefore, the longer the line length, the greater the minimum permissible conductor size. Typical recommended values are:

20- 200 feet #24 wire
200- 400 feet #22 wire
400- 700 feet #20 wire
700-1000 feet #18 wire

After you have decided upon the placement of the various stations, it is necessary to estimate conductor lengths, particularly between the master station and the farthest slave station, or between the two master stations that are separated the greatest distance. From this information, you can determine the type of cable that should be used in the installation.

For very long line runs, the most economical way to minimize audio power losses may be to increase the line impedance. As shown in Fig. 3, step-up and step-down line transformers are used to match the various intercom components to the medium-impedance (usually 500 ohms) line.

Follow Up the Installation

After determining the customer's needs and completing the installation, don't let him drop. From time to time, stop in and reevaluate the system with him. In many cases you'll be able to sell another unit or two, or a different type of system, to meet his changing needs. You'll also be able to arrest any loss of performance due to deterioration of components, or to tampering with the system.

Intercoms, unlike radio or TV sets, are fairly permanent. To modify them generally requires changes in wire routing and length, and other services of a qualified technician—you! ▲

Horizontal AFC

(Continued from page 37)

(C92) should be. Surprisingly, the appearance of the wiring and soldering gave every indication that the wrong value was used when the set was manufactured. Replacing the .001 with the correct value restored the kind of sync action that's normal for these models.

"Why?" you might ask, "should a set this old wait until now to start giving trouble with critical hold, if the wrong part was wired in at the factory?" When the improved holding action was demonstrated to the set owner, he admitted that poor hold had always been present. He had taken for granted the need for adjusting the hold control every time the set was turned on, or every time a station change was made.

More Typical Troubles

More often than not, scope probing will directly reveal which portion of the circuit is at fault. Sometimes the distorted signal is so badly abnormal it can't be missed; at other times, the distortion is so minor as to require a really close examination of the traces. Both situations, oddly enough, occurred in two different Zenith 20J21 chassis that had the same symptom—the horizontal slipping pictured in Fig. 7.

Fig. 7. Two Zenith sets had this same trouble symptom for different reasons.

Because the first set also seemed to have critical vertical hold, my first scope trace was taken at the plate of the 6BE6 sync separator (Fig. 8). With the scope set at one-half the horizontal frequency, I obtained the ragged pulse shown in Fig. 9A. The video signal feeding the 6BE6 tube was normal enough, so I deduced that the distortion was either in the separator stage, or fed back from the AFC through C60. My second surmise proved correct, for I found an exaggerated pulse signal (Fig. 9B) at pin 1 of the 6AL5 AFC tube. At pin 7 of the 6AL5, an even stronger pulse (Fig. 9C) was found. Since this last point is where the sample sawtooth signal is normally fed into the AFC tube, and since the distortion here was the most severe, the waveform clearly indicated a defect in the sample-signal feedback network. More precisely, the circuit's inability to attenuate and shape the flyback pulse suggested an open C74. Leaving the scope probe attached to pin 7 of the 6AL5, I bridged the suspected capacitor, and the signal became a normal 20-volt sawtooth. With a replacement part in-

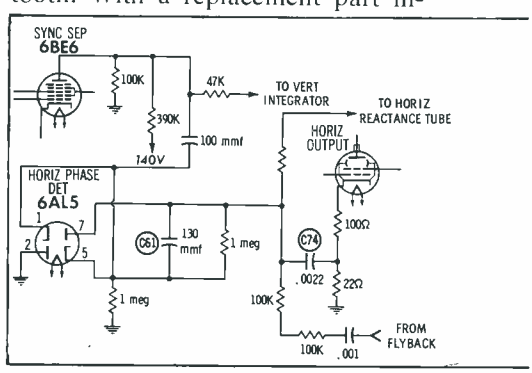


Fig. 8. Two different faults in this circuit were responsible for symptom.

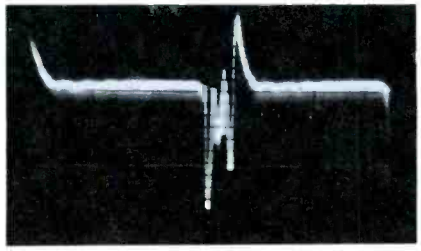
stalled, traces A, B, and C of Fig. 9 changed to their counterparts in Fig. 10. The amplitude was reduced to a normal 40 volts in Fig. 10A, with other traces in proportion. Incidentally, all the scoping was done with the 6AL5 out of its socket. With the tube installed, Fig. 10B borrows a greater sawtooth slope from the sample signal.

The other Zenith 20J21 did not have the same side effect of critical vertical hold. For this reason, I went directly to the AFC stage to begin troubleshooting. Removing the 6AL5, I scoped the AFC signals. At both pins 1 and 7, identical traces like Fig. 10C were found. Asking myself, "What could cause a direct connection between these pins?" I soon found a shorted C61.

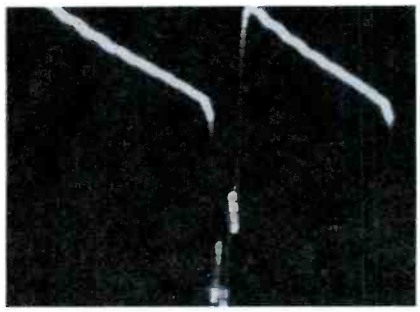
These cases very aptly demonstrate that scope traces should be critically examined for minor irregularities as well as for major distortions.

Triode AFC

There are two types of AFC cir-



(A) Sync-separator plate (85V p-p)



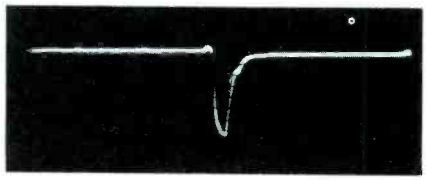
(B) AFC pin 1 (150V p-p)

(C) AFC pin 7 (over 200V p-p)

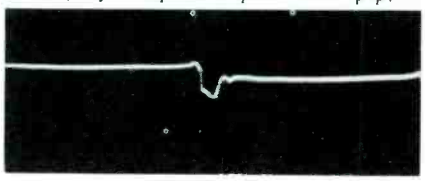
Fig. 9. Abnormal traces in first set.

cuits in which a single triode takes the place of dual diodes. One type operates similarly to the balanced diode system; two sync pulses of equal amplitude but opposite polarity are applied to the grid and cathode, with a sawtooth sample signal being applied to the plate. AFC correction voltage is developed between the grid and cathode and is taken off from between two resistors connected to these elements. This circuit might be considered as a balanced triode AFC, inasmuch as the amount of phasing and frequency correction is equal for either fast or slow operation of the oscillator. The pull-in frequency range is somewhat less than for dual-diode AFC.

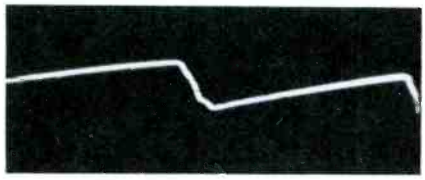
A second type of triode AFC approximates the unbalanced diode AFC circuit. A negative-going sync pulse is applied to the cathode, and a sample signal to the plate. Correction voltage is developed between plate and ground in some circuits; between grid and ground in others. This is probably the least common AFC system, and it is also probably the least efficient. It has less pull-in range, less noise immunity, and less tolerance to component-value shifts.



(A) Sync-separator plate (40V p-p)



(B) AFC pin 1 (15V p-p)



(C) AFC pin 7 (20V p-p)

Fig. 10. Normal traces for comparison.

Triode AFC systems have all the troubles that can arise in the diode systems, plus one more—namely, squegging. Of all the sets I've serviced, I don't remember a single instance where a defect in a diode AFC circuit produced squegging (although defects in a diode-controlled horizontal oscillator have done so). I have, however, seen several triode AFC systems—and I'm not talking about pulse-width systems—where defects in the AFC itself caused squegging. Fig. 11, photographed from a Motorola chassis TS-292, is a case in point. The cause of this wild symptom was an open integrating capacitor in the sample-signal network.

In servicing any type of AFC system, you'll benefit from using the scope early and often, and you should keep a sharp eye out for troubles in the sample-signal feedback network. Adhering to this advice will wrap up most AFC troubles for you. ▲

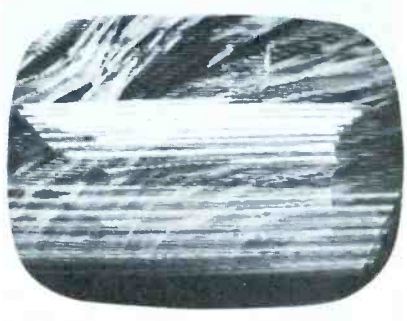


Fig. 11. Squegging caused by fault in operation of a triode-type AFC stage.

Intermittents

(Continued from page 31)

symptom of a snowy picture, which pretty well isolates itself to the tuner or antenna.) A normal video waveform, like that in Fig. 1—with constant amplitude and no distortion—proves the entire RF-IF section is free of intermittents. The next step, in this case, is to signal-trace (monitor style) through the video circuits.

If the detector-signal amplitude changes when the trouble appears, follow-up checks should be made of the AGC bias voltage, IF-amplifier plate voltages, and other factors that could alter gain. Signal-tracing through the IF's with a scope and demodulator probe can often be helpful, too.

Intermittent distortion of the detected video, as in Fig. 2A, is often a hint to make a complete check of the AGC circuit. Certain faults, like the "punched-in" vertical pulses in Fig. 2B, could indicate drifting of some RF or IF tuned circuit; defects of this sort can be further isolated by using a visual alignment setup for later monitoring tests.

B—Audio Detector

This point is helpful in trouble-shooting complaints that the sound "cuts out" or erratically changes in volume. We're not overlooking the volume control as a convenient point for dividing the sound section into two blocks for trouble isolation, but the sound IF and detector are such common offenders that we recommend a prompt attempt to divide one from the other.

An ordinary wideband scope will display the 4.5-mc detector-input signal well enough to let you check

It has a hysteria motor, I think.

its amplitude; see Fig. 1 for the characteristic pattern. If a normal signal is reaching the detector, you can continue to signal-trace with the scope until you find the erratic stage.

C—Sync Output

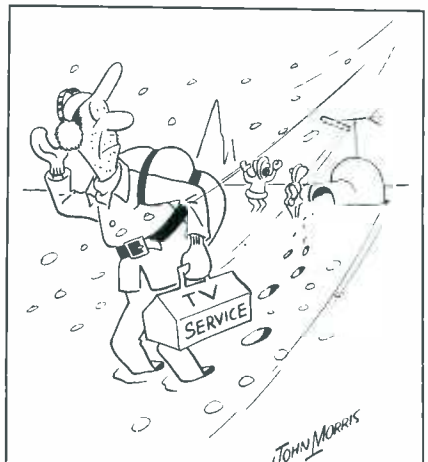
Scoping this point is essential for analyzing the cause of bending, rolling, jitter, and related troubles. The output pulses at the last sync stage should be strong, steady in amplitude, and free from all but the slightest trace of video. In a two-stage sync circuit, positive pulses like those in Fig. 1 are normal; but negative pulses can be expected if the sync separator is the only sync stage.

If any distortion or fluctuation of the trace is seen when the trouble appears, try to "box in" the fault by monitoring other points as far back as the video detector.

In cases of unstable *vertical* sync, you need a true picture of the signal actually reaching the vertical oscillator; thus, the output of the integrator is a better spot than point C for initial monitoring. Follow instructions in service data for disabling the vertical oscillator to get a clearer view of the sync pulse. Sometimes you'll find nothing wrong with the sync input; this is a clue to drifting of the oscillator. Monitoring voltages, as well as waveforms, in this stage should help you determine which part of the oscillator circuit is defective.

D—Horizontal Drive

A steady flow of letters across the editor's desk indicates that servicemen have more difficulty with



"How about that: Four dollars for one home service call!"

the horizontal sweep section than any other part of a TV receiver. The problem is multiplied by interaction between the horizontal oscillator and output stages, especially when an intermittent trouble is present. Thus, the most important check point associated with the horizontal section—and perhaps in the entire receiver—is the grid of the horizontal output tube. It's a waste of time to do much work on the flyback, boost, and high-voltage circuits without first making sure the grid is receiving a constant drive waveform of normal shape and amplitude.

If the drive signal is unstable, a "vicious circle" involving all the horizontal stages may have to be broken before you can go on. Grounding or disabling the AFC input to the oscillator will let you see if the oscillator can run steadily enough to develop a constant drive signal.

In receivers that use boost voltage as a plate supply for the oscillator, trouble almost anywhere in the horizontal circuit can complicate matters by varying the plate voltage. A positive method of isolating the defect is to connect the proper DC voltage to the oscillator plate from an outside source. Should this eliminate the intermittent problem, the output circuit can be assumed to be at fault and you can choose the next point to be monitored—perhaps the screen of the output tube, or the boost line.

Wrap It Up

All later steps in monitoring should have the object of picking out individual components or networks that might be defective. As far as possible, these suspected parts should be checked by substitution for a conclusive test—followed by a long enough period of "cooking" to verify the results.

Test Recordings

Here's a group of test records, made by CBS Laboratories, that are now available to hi-fi and stereo service technicians. Originally designed for use by broadcasting and recording studios, they offer a comprehensive group of test signals for

checking any recording or playback system.

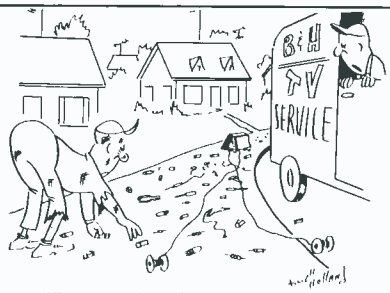
The specially prepared tracks on the four recordings contain waveforms for testing almost every conceivable factor in an audio system. Technical bulletins included with each record explain the various tests, and indicate which grooves contain the signals for each test.

One recording (STR 130) furnishes all the signals to perform sweep-frequency and spot-frequency tests in RIAA systems. The waveforms can be used to calibrate the recording equipment and for testing the entire playback system. Special bands check both channels of stereo systems, both separately and simultaneously.

Another (STR 111) furnishes square waves and combined-frequency signals for intermodulation and transient-response tests. A third record (STR 120) provides signals at 10 cps through 50,000 cps for testing wide-range pickups.

The fourth (STR 100) is a stereophonic test record for checking sweep and spot-frequency responses, channel separation, compliance, wavelength loss, stylus wear, and tone-arm resonance. Using this recording as the signal source, the stereo serviceman can check an entire system, from stylus to output transformer, for exact balance of channels and performance of the system as a unit.

For further information, circle 101 on the literature card. ▲



"For Pete's sake, Pheeny! Next time wait until I get the truck stopped to get out!"

Cartridge

(Continued from page 22)

Fig. 2. Most cartridges use slip-on terminals instead of solder connections.

defective cartridge? The answer to this question is sometimes very simple. If the sound output is quite low in volume, only one test may be needed—merely touching your finger to the "hot" terminal on the rear of the pickup assembly, and listening to the hum introduced into the amplifier. A loud sound from the speaker indicates the amplifier stages are functioning; therefore, the pickup must be bad. When distortion is the complaint, an easy (and logical) move is to install a new needle or cartridge, and recheck the output; if the sound is cleared up to the customer's satisfaction, the job is completed. The ease of replacement featured in most new cartridge designs makes it a simple matter to try a new unit.

Sometimes a quick substitution check is unworkable because the correct replacement isn't at hand, the trouble is too complex, or the customer is critical. In such cases, it's best to run a more detailed signal-tracing check, aided by audio test equipment, with a test record as a signal source. This "lab test" method is more time-consuming, but phonograph owners can be convinced it's well worth a higher service charge than for simply replacing a part.

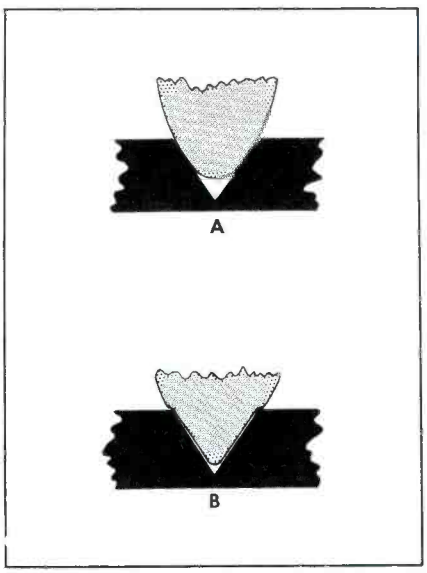


Fig. 3. A worn needle, with flattened sides, increases the wear on records.

Needle Tips

Long before the entire cartridge needs replacing, new needles will probably have to be installed. The stylus assembly for the cartridge shown in Fig. 1, as in most stereo and monophonic units now in use, contains two separate needles: one for microgroove recordings (33 and 45 rpm), and the other for 78-rpm recordings. The great majority of present cartridges have a .7-mil needle tip (stereo) or a 1-mil tip (monophonic) for microgroove, and from 2 to 3 mils for 78-rpm records.

Modern needle tips, except for a few low-priced types made of osmium (a precious metal), are either sapphire or diamond. The latter is fast becoming the most popular tip, mainly because it gives a longer playing time without developing worn spots that damage records.

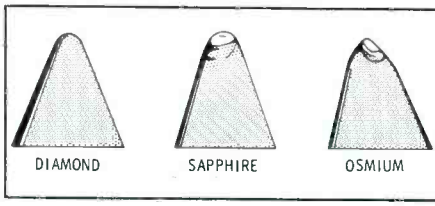


Fig. 4. Playing 15 LP records caused this much wear on different needles.

The *safe* playing time for a diamond needle averages from 750 to 1500 hours. Compare this with 60 to 100 hours for a sapphire, and only 20 or 30 hours for an osmium type. Fig. 3A shows how a new needle fits into the groove of a record; B shows how a *worn* needle fits the groove. When the needle is *new*, the point is round and smooth, and contacts only a small area on the upper walls of the record grooves. Now, look at what happens when the needle becomes worn! The point is no longer round; it has flattened, notched edges that gouge deeper into the record groove. When a needle is in this condition, sound distortion usually occurs, and worse, the wavy impressions in the record grooves will tend to be "bulldozed" away. The record, if played repeatedly, will be permanently damaged.

Fig. 4 compares the tips of diamond, sapphire, and osmium needles after 15 plays at 8 grams pressure. Notice how worn the sapphire and osmium types are, and how well the diamond tip has held up. Actually, the cost *per hour of playing time* is a whopping one-fourth cheaper for a typical diamond than for a sapphire with a much lower initial cost. These facts should be pointed out to a customer when he needs a new needle or cartridge assembly.

Maybe he's already aware that a worn needle has adverse effects on

Fig. 5. Pressure of tone arm bends the spring, which acts as scale pointer.

the grooves of a record, and has been keeping track of playing time. But he may have overlooked another cause of excessive record wear: improper pressure applied by the tone arm to the record. An explanation of this point, and an offer to check his tone-arm pressure, is part of a thorough service job.

This test can be made in a matter of minutes, using one of the commercially available pressure gauges. Depicted in Fig. 5 is an inexpensive gauge (it costs a couple of dollars) being used to measure tone-arm pressure on a turntable. This foreign-made type requires a pressure of from 10 to 12 grams, and our gauge pointer is sitting on the lower limit of this range. The pointer is actually a metal spring with two separate slots to hold the needle and keep it from slipping. The upper slot is used to obtain a readings in grams; the lower one gives an indication in ounces.

You'll need to check the service information on the particular piece of equipment you're servicing for the correct tone arm pressure. Usually, the pressure on domestic changers is much lower than on the unit shown here—somewhere around 6 grams, plus or minus one or two. The adjustment for resetting tone-arm pressure is usually a metal screw located on the rear of the arm; its operation is fairly simple.

In Fig. 6, we've shown a more elaborate type of pressure gauge that sells for around $10. The changer pictured here is the same as in Fig. 5; however, we reset the pressure-adjustment screw, making the meter read close to 13 grams. This type of gauge is a little more accurate than the other type shown, and will allow setting the pressure within closer tolerances.

A simple check on tone-arm pressure is important from the customer's viewpoint, once he understands its purpose; so it should also be important from your *business* viewpoint!

To Locate a Replacement

Finding a correct replacement for a defective cartridge usually presents no problem, since a wide variety of direct replacements are available from many different manufacturers. Most replacement catalogs and brochures have two or three cross-reference listings, such as the original cartridge manufacturer's part number, and replacement cartridge numbers. Usually, these catalogs include electrical specifications and physical dimensions of different cartridges, in addition to other valuable information. With so many replacements available, when a cartridge is "finished," the choice of replacements is yours! ▲

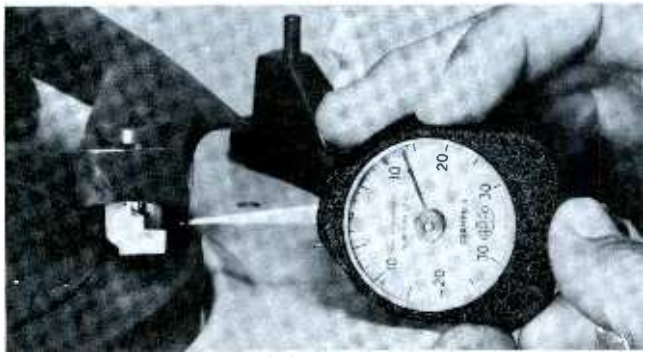
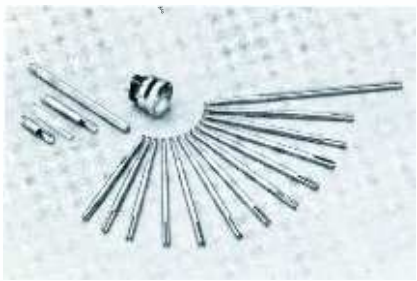


Fig. 6. More elaborate pressure gauge gives readings from rotating pointer.

PRODUCT report

For further information on any of the following items, circle the associated number on the Catalog & Literature Card.



Control Accessories (67C)

Centralab has announced the addition of 14 new items to the "Fastatch II" replacement control system for fabricating TV controls with push-pull switches.

Among the accessories are a KR-8 push-pull line switch which snaps onto the rear of any dual concentric "Fastatch II" control; a snap-in universal shaft and twelve exact-replacement shafts in various sizes round out the group. These accessories combine with any Fastatch II control to exactly duplicate push-pull control-and-switch combinations in many TV models.

UHF Converters (68C)

A new line of **General Instrument Corp.** one- and two-tube UHF converters, styled to complement most TV sets, provides simple adaptation of any VHF television receiver to all-channel reception.

Models TC-10 (one tube) and TC-20 (two tubes) both meet FCC requirements for oscillator radiation; they employ the F. W. Sickles (a G-I division) UHF tuner Model 204. Each unit weighs about 6 lbs, measures 9½″ × 4″ × 5″, and is available in a wide variety of both painted and vinyl-clad cabinets with matching knob combinations.

Both converters cover channels 14 through 83 continuously, with approximately 9 mc overtravel at each end of the band. Channels are equally spaced over the entire tuning dial for simplified tuning without station crowding.

In the Model TC-20, a jewel light indicates UHF operation. The output of the mixer is amplified by a 6CW4 nuvistor to provide high gain over the entire UHF band.

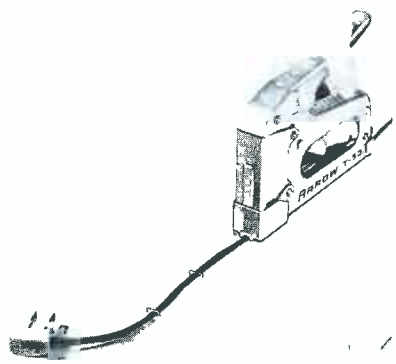
AM-Shortwave Transistor (69C)

Designated the 2N2672, this new **Amperex** transistor is for use in RF or IF stages from standard broadcast frequencies up to 6 mc. It is especially suitable for use in battery-operated car and portable radios, since it operates at supply voltages as low as 3.0 volts. The 2N2672 features low internal feedback capacitance, low collector leakage, high signal-current gain, and high collector-base breakdown voltage (greater than 25

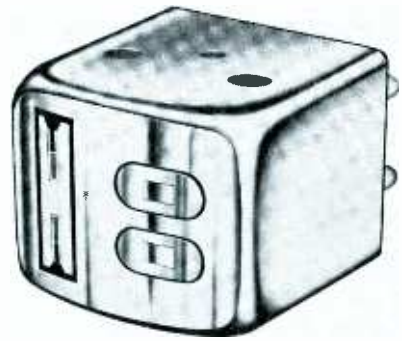
volts). The unit also has a low collector capacitance and low output conductance to facilitate use in highly selective circuits. Housed in the standard TO-39 case, it has a low conversion-noise figure and good AGC performance at high temperatures.

Gun Tacker Attachments (70C)

Three brand-new accessories for the widely-used **Arrow** T-50 Gun Tacker are: A screen attachment for use on all types of screening, such as window and porch screens; a wire attachment for electrical wiring, wire fencing, netting, plant stems, etc.; and a window-shade attachment for fastening window shades to poles, or cloth or material to any round object or doweling. These interchangeable acces-

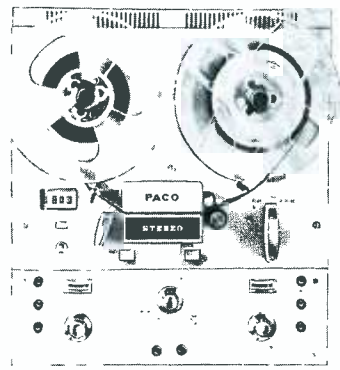


sories snap on over the front of the staple gun. The attachments, and also the SL-50 Staple Lifter, have been individually pre-packaged on skin-packed, pilfer-proof display cards for self-service buying. The attachments, which retail for $1.00 each, are packed six to the box and three dozen to the carton.



Compact Tape Heads (71C)

Nortronics Co., Inc., has developed a new series of magnetic-tape heads which will allow more compact construction in the above-deck design of tape recorders. Each head, combining record, play, and erase functions, measures only .490″ high, .575″ wide, and .580″ deep. The complete line includes four-track and two-track stereo heads; four-track, two-track, and full-track monophonic heads; and heads with custom configurations for specialized applications. Each head features laminated construction with quartz gaps, precision-polished all-metal face, and either hyperbolic or cylindrical face contour. Phenolic connector plugs are available for all models.



Tape Deck and Preamp Combination (72C)

Featuring a completely integrated dual preamplifier, the **PACO** three-speed stereo tape deck permits four-track and two-track stereo or mono recording and playback, and has facilities for "sound with sound" recording. This versatile unit is suitable for either rack mounting or custom installation. Other features include: two separate VU meters, individual volume controls for each channel, digital tape index counter, automatic tape shutoff, and fast forward and rewind controls. The unit has a frequency response of 30-15,000 cps ±3 db at 7½ ips; flutter and wow are less than 0.4% at 7½ ips.

Multi-Impedance Speaker (73C)

A new line of multi-impedance replacement speakers from **Oaktron Industries** promises to cut unnecessary stocking by one-third. By utilizing multi-

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ple-winding voice coils, a single speaker is able to match any of three commonly used audio-output impedances—10, 20, or 40 ohms. Each speaker has a clearly detailed wiring diagram conveniently located near the voice-coil terminals. These speakers are available in standard 4″ × 10″ and 5″ × 7″ sizes, and in 6″ × 9″ with shallow profile. All types utilize an aluminum voice coil plus extra-heavy windings to handle maximum power without overheating or loss of efficiency. Their rugged construction allows them to withstand ambient temperatures up to 105° C encountered in some automotive applications.

Precision Pocket Microscope
(74C)

This pocket microscope, a product of **Jonard International Corp.**, features optically ground and polished lenses for precision inspection of microminiature components. The pocket microscope fills the gap between a pocket magnifier and a vertical microscope with magnification of 40X, 50X, and 60X.

The instrument also has a built-in mirror that condenses and reflects light. This feature comes in handy for inspecting in small, dark areas. The unit comes in satin black and chrome finish, with a pocket clip and protective leatherette case. Designated the Model M-1, it is priced at $12.50.

CATALOG AND LITERATURE SERVICE

ANTENNAS & ACCESSORIES

1C. *ANTENNACRAFT*—Catalog sheet, illustrated in color, with complete performance and pricing information on new *Gold UHF* antennas — single, stacked, or in kits.

2C. *ANTENNA SPECIALISTS*—Complete set of catalog pages listing outstanding features of both amateur and Citizens-band beam antennas.

3C. *BLONDER-TONGUE* — Quick-reference index for all types of home antenna products: signal amplifiers, UHF converters, matching transformers, traps, etc. Also 16-page reference manual for master TV systems.*

4C. *CHANNEL MASTER* — Brochure describing *Super-Crossfire* high-gain antenna, designed for both stereo-FM and TV reception.

5C. *CUSH CRAFT*—Illustrated brochure on complete line of Citizens-band antennas and accessories, including *Blitz Bug* coaxial lightning arrester.

6C. *GALLO*—Descriptive brochure on FMS-101, an FM antenna system with transistorized preamplifier, entirely contained within decorative 6½" x 3¾" x 1-3/16" case.

7C. *JERROLD ELECTRONICS* — 6-page, color-illustrated catalog on *Paralog*, new line of log-periodic antennas with modular parasitic elements, for VHF TV and FM installations.*

8C. *JFD*—Specifications and operating information on *Transis-tenna* and newly-designed, long-range *LPV* log-periodic TV antennas. Illustrated brochure showing entire line of indoor antennas and accessories for TV and FM.

9C. *WINEGARD*—New *Fact-Finder* booklets on line taps, "K" series antennas, FM antennas, and multiset couplers.*

10C. *ZENITH*—Informative bulletin on new line of log-periodic vee-type antennas for FM, and for monochrome and color TV.*

AUDIO & HI-FI

11C. *ADMIRAL, National Service Div.*—Recently published catalog listing replacement parts and accessories, with special cross-reference guide to phonograph needles and cartridges.

12C. *ATLAS SOUND, Div. of American Trading and Production Corp.*—New illustrated catalog number 563, containing specifications of microphone stands and loudspeakers for use in public address, commercial, or industrial installations.*

13C. *DUOTONE*—Supplemental 1963 catalog and needle-replacement Wall Chart.

14C. *ELECTRO-VOICE*—Three informative catalogs: General catalog No. 157, High-Fidelity catalog No. 159, and Commercial Sound catalog No. 158.*

15C. *EUPHONICS* — Four informative brochures illustrating ceramic phono cartridges and microphones; cartridge cross-reference index is included.

16C. *OAKTRON*—"The Blueprint to Better Sound," an 8-page catalog of loudspeakers and baffles giving detailed specifications and list prices.

17C. *PERMA-POWER* — Descriptive literature on battery-operated, portable sound systems: *Roving Rostrum and Diplomat.**

18C. *PRECISION ELECTRONICS* — Bulletin 101 describing popular Model 502M stereo tuner-amplifier, now offered at new lower price.

19C. *QUALITONE* — Wall chart, with needles pictured, for cross-reference of all popular needle replacement needs.

20C. *QUAM-NICHOLS* — *Speaker Replacement Guide* listing the speakers used in all automobiles from 1955 through 1962.

21C. *ROBINS*—Special Reference Guide for phonograph and recorder drive belts and wheels; lists all popular units and specifies Robins replacement.

22C. *SARKES TARZIAN*—"Lower the Cost of Fun With Tape Recording," a large 32-page booklet containing information about tape recorders. Ways of using recorder as a notebook, for tricks, for recording unusual sound sources, are all explained in this informative booklet.*

23C. *SONOTONE* — Special cross-reference catalog for cartridges, listing many popular brands of phonographs; descriptive literature on *Sono-Flex* needle.*

24C. *SWITCHCRAFT* — New Product Bulletin No. 129 describing color-coded phone plugs with cable clamp and plastic snap-on handles in red, black, and white.*

COMMUNICATIONS

25C. *CADRE INDUSTRIES* — Detailed information on 5-watt Citizens-band units, and on new 1.5-watt hand-held transceiver.*

26C. *ELECTRONIC COMMUNICATIONS, INC.* — Illustrated leaflets describing line of communications gear, including CB transceiver and 30-watt linear amplifier.

27C. *RAYTHEON* — Descriptive sheet on *Ray-Tel* CB communications system, using solid-state frequency synthesizer.

COMPONENTS

28C. *BUSSMANN*—24-page bulletin SFB detailing information on the complete line of *BUSS* and *FUSETRON* small-dimension fuses and fuseholders used in protecting electronic equipment.*

29C. *COLUMBIA WIRE* — Comprehensive catalog 110 describing many service-dealer wire needs plus an array of multicolor coax cables.*

30C. *LITTELFUSE* — Form L-562 showing prices and specifications on complete line of fuses, fuse holders, and merchandising aids.*

31C. *SPRAGUE*—Latest catalog C-615 with complete listings of all stock parts for TV and radio replacement use, as well as *Transfarad* and *Tel-Ohmike* capacitor analyzers.*

32C. *STANCOR ELECTRONICS* — Durable wall-card tabulating proper output transformer to use with each of 260 different audio output tubes; includes specifications for each transformer recommended.

33C. *TRIAD*—New catalog TV-63/64 lists many replacement items for radio, TV, and hi-fi.*

SERVICE AIDS

34C. *CASTLE*—How to get fast overhaul service on all makes and models of television tuners is described in leaflet, which also contains a comprehensive list of universal and original-equipment tuners.*

35C. *CHEMTRONICS*—Brochures illustrating dozens of chemical products for TV and radio use. Includes information on new *Jet Spare* aerosol-spray compound that seals tire punctures and re-inflates tire in one operation.*

36C. *COLMAN* — New 1963-64 catalog of radio-TV replacement components and service aids.

37C. *ELECTRONIC CHEMICAL CORP.* — Catalog listing chemical sprays for cleaning and lubrication in all types of electronic equipment.*

38C. *INJECTORALL* — New 1963 catalog showing complete line of chemicals used in electronics.*

39C. *PRECISION TUNER*—Literature supplying information on complete, low-cost repair and alignment services for any TV tuner.*

40C. *STANDARD KOLLSMAN* — Tuner replacement guide, covering all TV sets from 1947 through 1962, with replacement parts listings.*

41C. *WORKMAN* — General catalog CAF-102, fusible resistor and circuit breaker cross-reference guides, information on transistorized auto ignition system, and power converter sheet 25C.*

42C. *YEATS*—The new "back-saving" appliance dolly Model 7 is featured in a four-page booklet describing feather-weight aluminum construction.

SPECIAL EQUIPMENT

43C. *ATR*—Descriptive literature on selling DC-AC inverters for operating 117-volt PA systems, tape recorders, and other electronic gear in vehicles such as automobiles, boats, aircraft, etc.*

44C. *GC ELECTRONICS*—Giant-sized catalog FR-65 contains 330 pages, forming the most complete listing yet published of new products and equipment offered by all company divisions.*

45C. *GREYHOUND*—The complete story of the speed, convenience, and special service provided by the Greyhound Package Express method of shipping, with rates and routes.

46C. *SIMPSON*—Latest series of VOM's are described in test-equipment bulletin; also information on line of automotive test equipment.

47C. *SWITCHCRAFT*—Bulletin No. 129 describing new series 3508 color-coded phono plugs, with snap-on colored handles and positive-grip cable clamp; simplified stereo, hi-fi, and test equipment hookups.*

48C. *TERADO*—Sheet depicting wide line of 60-cps mobile power inverters and several types of battery chargers.

49C. *VOLKSWAGEN*—Large, 60-page illustrated booklet "The Owner's Viewpoint" describes how various VW trucks can be used to save time and money in business enterprises; includes complete specifications on line of trucks.*

TECHNICAL PUBLICATIONS

50C. *CLEVELAND INSTITUTE OF ELECTRONICS* — "Pocket Electronics Data Guides" with handy conversion factors, formulas, tables, and color codes. Additional folder, "Choose Your Career in Electronics," describes home-study electronics training programs, including preparation for FCC-license exam.

51C. *HOWARD W. SAMS* — Literature describing popular and informative publications on radio and TV servicing, communications, audio, hi-fi, and industrial electronics; including special new 1963 catalog of technical books on every phase of electronics.*

TEST EQUIPMENT

52C. *ANTRONICS*—General catalog describing Anchor Model T-475 *Reacto-Tester*, which repairs, analyzes, and tests every type of picture tube.

53C. *B & K* — Catalog AP-21R describing uses for and specifications of new Model 1074 Television Analyst, Model 1076 Television Analyst, Model 850 Color Generator, Model 960 Transistor Radio Analyst, new Model 445 CRT Tester-Rejuvenator, new Model 230 Substitution Master, Model 375 *Dynamatic* VTVM, Model 360 *V-O-Matic* VOM, Models 700 and 600 *Dyna-Quik* Tube Testers, and Model 1070 *Dyna-Sweep* Circuit Analyzer.*

54C. *EICO*—Catalog sheet on new Model 430 small general-purpose oscilloscope, with 3" screen.*

55C. *ELECTRO*—Illustrated folder gives all the lowdown on low-cost power supplies for transistor or auto-radio servicing; lists 18 different units for various applications.*

56C. *HICKOK* — Complete descriptive and operating information on Model 661 *Chrom-Aligner* standard NTSC color-bar generator.

57C. *MERCURY*—Catalog giving full information on Models 1000, 1100, and 1200 Tube Testers, Models 202 and 203 Self-Service Tube Testers, new Model 301 Combination Tester, new Model 501 Component Substitutor, and Model 800 CRT Tester-Reactivator.*

58C. *SECO* — New four-page catalog describes *Vari-Volt* units for controlling lighting, heating elements, or AC-DC motors up to 15 amps.*

59C. *SENCORE* — Special, newly released data on color test equipment, including the entirely new, low cost CG126 Color Generator, CA122 *Color Circuit Analyzer*, and PS120 *Wide-Band Scope.**

60C. *TRIPLETT*—Catalogs displaying complete line of test equipment for servicing, and industrial meters for all purposes.*

TOOLS

61C. *BERNS*—Data on unique 3-in-1 picture-tube repair tools, on *Audio Pin-Plug Crimper* that enables technician to make solderless plug and ground connections, and on *ION* adjustable "beam bender" for CRT's.*

62C. *ENTERPRISE DEVELOPMENT* — Time-saving techniques in brochure from Endeco demonstrate improved desoldering and resoldering techniques for speeding up and simplifying operations on PC boards.*

63C. *EVERSOLE* — Sheets describing and listing prices of *DeSod* desoldering tools for removing and replacing parts on printed circuit boards, including new tip for miniature IF transformers.

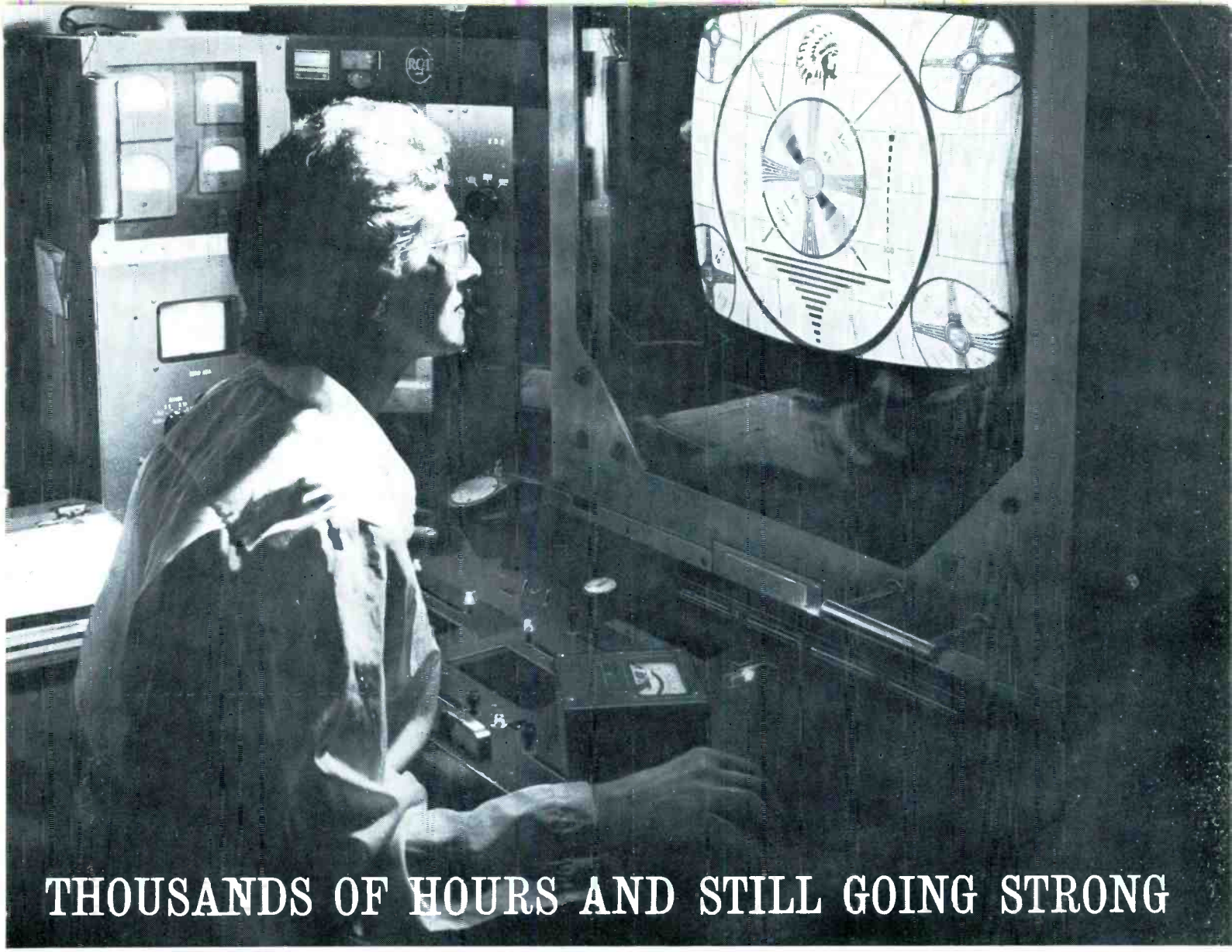
64C. *XCELITE* — Bulletin N563 describing three compact tool sets (PS88, PS120, and PS7) containing pocket-sized nut-drivers and/or screwdrivers with "piggy-back" torque-amplifier handles.*

TUBES AND TRANSISTORS

65C. *AMPEREX* — Catalog specifically devoted to extensive line of silicon planar epitaxial transistors. Describes applications for different types, with their basic specifications.

66C. *SEMITRONICS* — New updated 16" x 20" wall chart CH7 lists replacements, with substitution data, for 2000 U.S. and foreign transistors.

*Check "Index to Advertisers" for further information from this company.



THOUSANDS OF HOURS AND STILL GOING STRONG

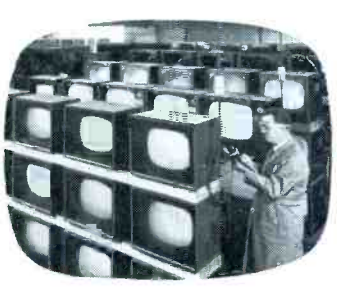
How RCA Assures Long Life in Silverama® Picture Tubes

In the darkness of the Life Test Rating Lab at our Marion, Indiana picture tube plant, a skilled operator studies the performance of an RCA Silverama picture tube that has been in operation thousands of hours.

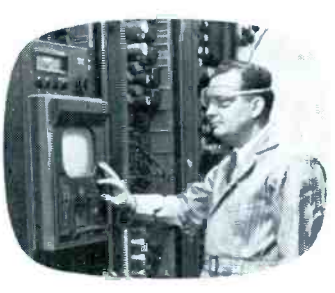
Life testing takes place in banks of actual TV receivers. After this gruelling life test, tubes are rated in a precision test unit for focus, brightness, resolution, emission, amount of leakage to all elements—every factor that affects performance—to determine the exact degree of deterioration produced during life testing. And this is but one of many different quality control checks to which every run of Silverama picture tubes is subjected.

What does this mean to your business? It means long-term customer satisfaction with every Silverama you install. The wide consumer acceptance of Silverama picture tubes is your assurance that your customer will call you again when he needs to replace his picture tube.

Today's Silverama is made with an all-new electron gun, finest parts and materials, and a used envelope that has been completely scrubbed internally, polished, and rescreened to restore it to the peak of its optical capabilities.



Picture Tube Life-Test Banks. Here RCA determines how Silverama picture tubes perform in actual TV receivers of all makes, under actual operating conditions, for thousands of hours of continuous service.

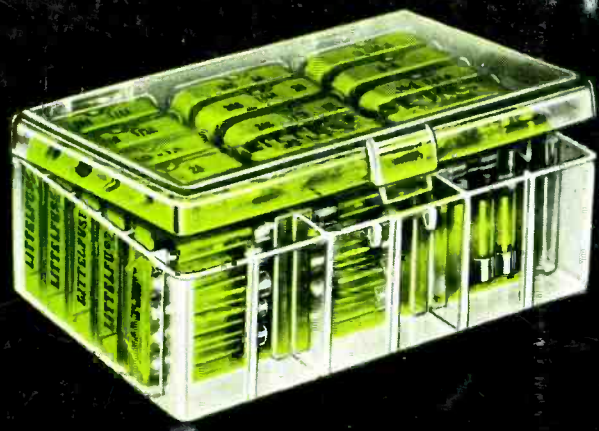


Precision Signal Generator sends out the test pattern shown on the screen above. Fidelity of reproduction of this virtually perfect signal (resolution: up to 2,000 lines!) is an accurate index of the picture tube's performance after life testing.

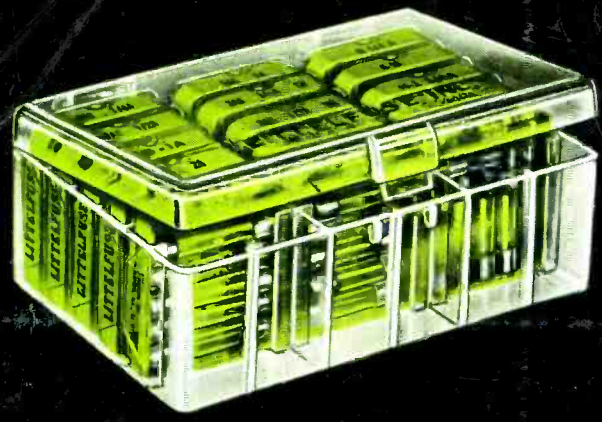
RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N. J.

RCA® **The Most Trusted Name in Television**

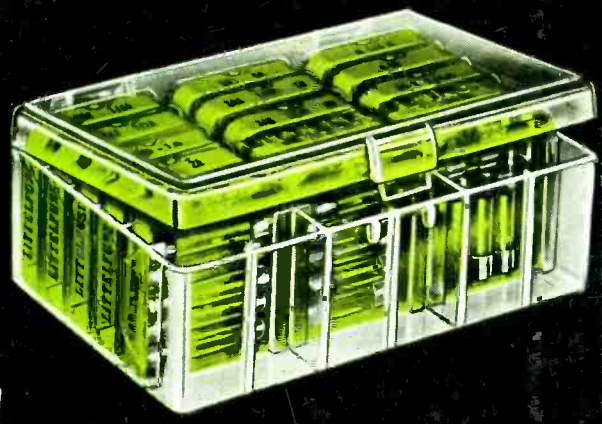
See the caddy



See the fuse box through the caddy



See the fuses through the fuse box through the caddy



See more profits through

LITTELFUSE

DES PLAINES, ILLINOIS