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PUBLISHER: Chris Hansen, P. O. Box 1226, New York, NY 10159. * * * * * * * * * * *
EDITOR: Dallas Lankford, P. O. Box 6145, Ruston, LA 71272–0018. * * * * * * * * * * *
CONTRIBUTING EDITOR: Skip Arey, P. O. Box C–4, Cinnaminson, NJ 08077. * * * *

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EDITOR'S CORNER

Because this is your newsletter, you might like a brief description of the current procedure by which an issue of *HSN* is created. I usually begin editing the next issue about 3 months in advance, so today, August 25, *HSN* **15** has started its journey towards camera-ready copy. It is apparent that you should submit potential contributions at least 3 months in advance to be guaranteed consideration for the next issue, and that an item may easily wait 6 months *or longer* before it appears in print. Submission of material is no guarantee that it will be published, but we do *try* to use almost everything eventually. Layout, editing, and typesetting considerations may also delay publication of individual submissions. After an issue is almost finished, it is mailed to Chris for proofreading, and he adds his Publisher's Corner at that time. Next it comes back to me for final revisions, and finally a camera-ready copy is mailed to Chris. I'll ask Chris to describe the publishing and mailing procedure in his column.

About a month ago I received an upgrade of my typesetting software which is greatly improved and permits me to do things which were previously impossible. Among the improvements is an enhanced version of a TEX extension called LATEX, developed by Leslie

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Lamport. This extension includes a "picture environment" in which one can compose drawings formed from straight line segments and quarter circle arcs of five predetermined radii using two predetermined line and arc thicknesses. That may not sound like much, and it isn't, because it takes an incredible amount of time to compose even a simple picture. But TEX and LATEX provide powerful macro features which I used to develop a simple schematic typsetting program. This issue of *HSN* is, therefore, *the schematic issue* in which I will give my schematic macros a thorough testing. I hope you like the show. My schematic typesetting macros are still in the process of development, and there are currently some things I can't easily do. So I will devote this issue mainly to a continuation of my mechanical filter discussion. This will also provide some additional time for *all* of you to send me something to put in the spring and summer 1987 issues.

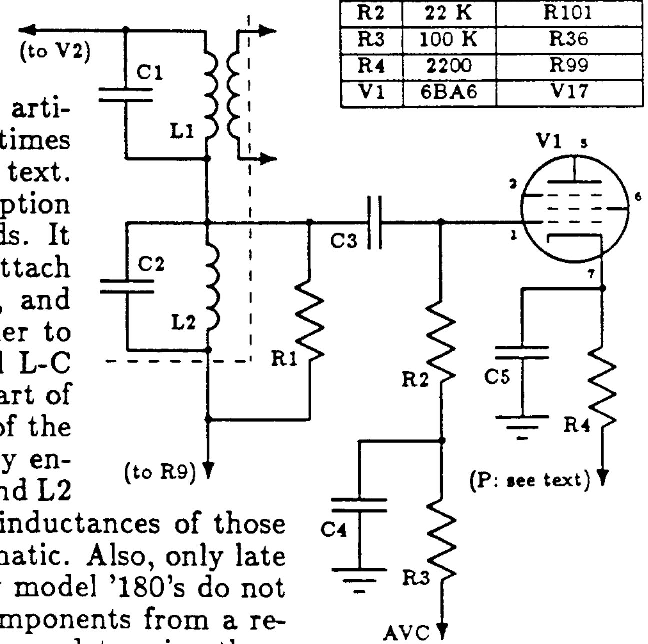
COLLINS DISC–WIRE MECHANICAL FILTERS, Part 3

DALLAS LANKFORD

Recall that in Part 2 (*HSN* **12**) I discussed the two general kinds of mechanical filter circuits which are used when AVC is needed at the output, namely series and parallel AVC. In Part 3, I will present some applications of those two general approaches, using suggested before and after circuits for some common tube type communucations receivers. Let me begin with a description of an HQ–180(A) mod which I have done to my own '180. A more detailed discussion of this mod is contained in *'180 + Collins F455FA40 Mechanical Filter = Super-'180* which may be ordered from the **National Radio Club**, Publications Center, P. O. Box 164, Mannsville, NY 13661, or you may order a 5 page revision of this article directly from me for $1 and a SASE.

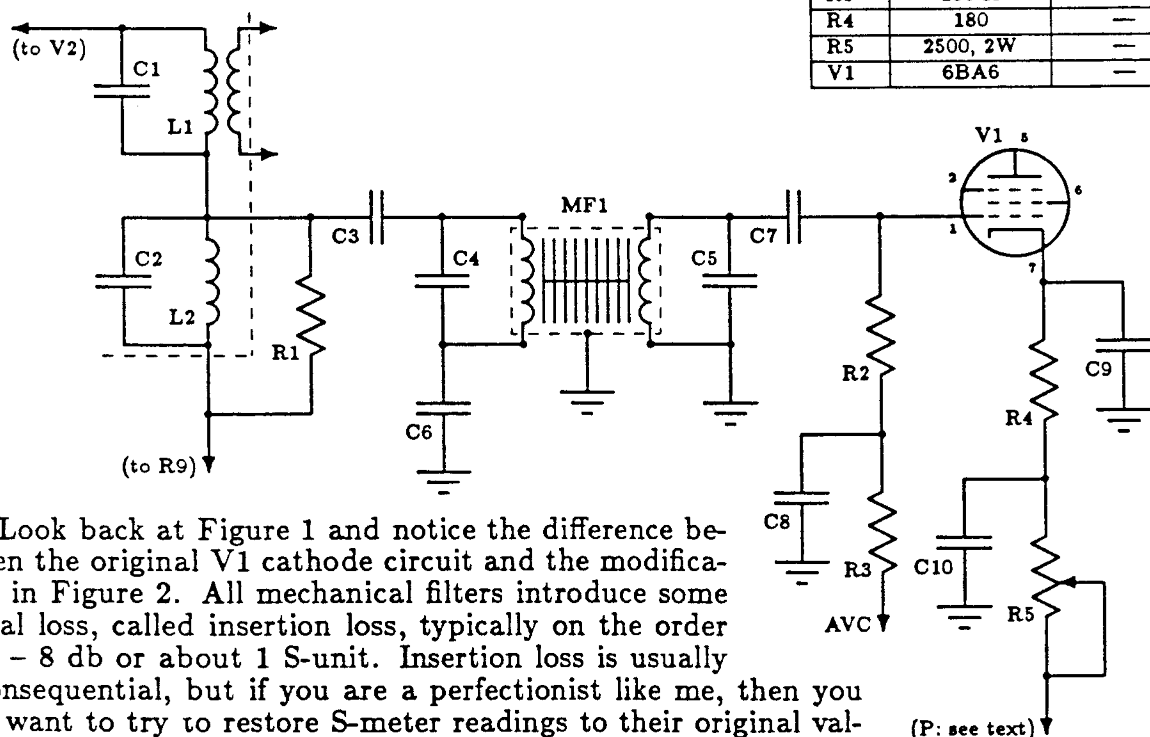
The format I will use to display schematics is illustrated in Figure 1, a small section of a late model HQ–180A schematic. The figure labels are not (usually) the same as '180 labels, which are listed in the column under "HQ–180(A)." To avoid ambiguity and confusion, when I refer to the labels from a receiver schematic I will enclose them in parentheses. For example, C3 in Figure 1 is (C134) on a '180 schematic. I have also deleted some details from the original schematics to conserve space and simplify schematics. For example, the original '180 schematic indicated that a shielded cable connected the junction of C2, L2, and R1 to C3. However, in all cases there should be enough details for you to associate the figures from this article with actual receiver schematics. Sometimes additional information will be given in the text. For example, Figure 1 contains the the caption "(P: see text)" beside one of the arrowheads. It would have been awkward or unsightly to attach the label "(to junction of R14, R15, R18, and C20)" at that point, and it is much simpler to refer to that point as point P. The parallel L-C tuned circuits L1-C1 and L2-C2 are both part of transformer T1, and I have omitted some of the shielding (dashed line) which should entirely enclose them. The question marks beside L1 and L2 in column 2 of Figure 1 indicate that the inductances of those two inductors is not given on the '180 schematic. Also, only late model '180's have C5 (C158) and very early model '180's do not have R1 (R107). The voltage ratings of components from a receiver schematic are not given because you can determine them

Figure 1		HQ–180(A)
C1	22	—
C2	90	—
C3	2	C134
C4	.01	C130
C5	.01	C158
L1	?	—
L2	?	—
R1	100 K	R107
R2	22 K	R101
R3	100 K	R36
R4	2200	R99
V1	6BA6	V17



from the original schematic or parts list. Voltage ratings of added components in modifications, such as in Figure 2, are generally given, except for half watt resistors whose ratings are omitted. The mechanical filter type (second column entry beside MF1) and resonating capacitors (second column entry beside C3 and C4) are not specified. Any FA, FB, or N series mechanical filter is suitable for any of these modifications. The values of the resonating capacitors Ct for each filter have already been given in Part 1 (*HSN* **11**). If you have an older '180 which does not have R1 (R107), it is not necessary to add a 100 K resistor. I removed R1 (R107) from my '180 to determine if there was any noticable difference, but could detect none.

	Figure 2	HQ-180(A)
C1	22	—
C2	90	—
C3	.01, 1 KV	—
C4	Ct (see text)	—
C5	Ct (see text)	—
C6	.01, 1 KV	—
C7	.01, 1 KV	—
C8	.01	C130
C9	.01	C158
C10	.01, 1 KV	—
L1	?	—
L2	?	—
MF1	see text	—
R1	100 K	R107
R2	100 K	—
R3	100 K	R36
R4	180	—
R5	2500, 2W	—
V1	6BA6	—



Look back at Figure 1 and notice the difference between the original V1 cathode circuit and the modification in Figure 2. All mechanical filters introduce some signal loss, called insertion loss, typically on the order of 6 – 8 db or about 1 S-unit. Insertion loss is usually inconsequential, but if you are a perfectionist like me, then you will want to try to restore S-meter readings to their original values. In many modifications there are easy ways to do this, and the modified cathode circuit of Figure 2 illustrates one such method. Notice that R4 of Figure 1 has been replaced by R4, R5, and C10 of Figure 2. For reasons which I will discuss later, you should not replace R4 of Figure 1 by a 2500 ohm 2 watt variable resistor in an attempt to simplify the cathode modification.

The AVC feed for V1 of Figures 1 and 2 is parallel. Because R3-C4 of Figure 1 [R3-C8 of Figure 2] is part of the '180 time constant circuit, they should not be changed [and have not been changed]. The load resistor R2 has been changed from 22 K in Figure 1 to 100 K in Figure 2. Collins recommends load resistors of at least 50 K for FA, FB, and N filters. You may use any value in the 50 K – 500 K range.

The filter input circuit is not the same as recommended by Collins, partly because L1-C1 and L2-C2 are switched by the '180 depending on the band, making it difficult to design and construct an alternate circuit. Also, it makes no sense to unnecessarily remove parts while modifying a receiver. So the input circuit takes advantage of the existing 455 kHz IF transformer L2-C2, and is typical of many modifications except that R1 will usually not be present.

Figure 3 is a small piece of a SP–600 schematic showing the 455 kHz gate V1 (V7), the 3.955 mHz to 455 kHz converter V2 (V6), and part of T3, the 455 kHz IF transformer which includes a multiposition 455 kHz crystal filter. In contrast to the '180 modification which provides mechanical filter selectivity only for the low bands, bands 1 – 4, the modification of the SP–600 in Figure 4 provides mechanical filter selectivity for all bands. Assuming there is ample space inside the SP–600 chassis near T3, the Figure 4 modification should be especially easy. It only requires disconnecting the B+ line at the junction of C3 and R1 in Figure 3 (never having seen a SP–600, I am not sure where C10 attaches to the B+ line ..., you may be able to use C10 in place of C2 if it attaches appropriately), and disconnecting the wire which joins the junction of V1 and V2 pins 5 and the junction of L1-C1 of Figure 3. The modification in Figure 4 requires a mechanical filter of your choice (I like the N series), a 10 mH 100 mA choke (you can cannibalize a nice 12 mH choke from an R–390A IF subchassis), a 2200 ohm half watt resistor, five .01 1KV disc ceramic capacitors, two filter resonating capacitors Ct [C3 and C4], some stranded hookup wire, perhaps a few short pieces of coax, a little aluminum metal or printed circuit board work to fabricate a mounting arrangement for the filter, and you are in business. A similar modification could also be done to the '180 because it uses a similar conversion scheme [following V1 of Figure 1]. The only differences are the '180 high IF is 3.035 mHz [which does not affect the modification], the bypass capacitor C9 and dropping resistor R2 of Figure 4 are outside the '180 IF transformer, and the '180 has no bypass capacitor corresponding to C10 in Figure 4. The main reason I did not do a Figure 4 style modification on my '180 is because I wanted a mechanical filter immediately following the first mixer for best BCB performance.

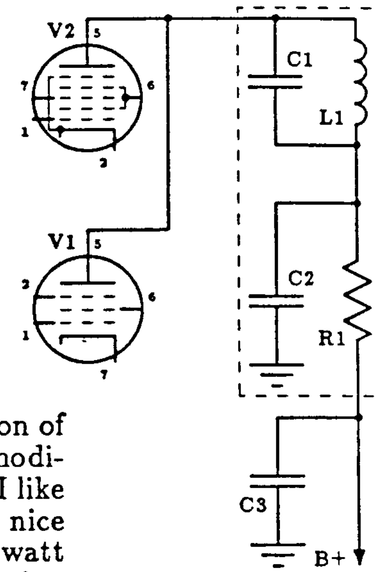


Figure 3		SP–600
C1	220	C107
C2	.022	C108
C3	.022	C109
L1	?	L36
R1	2200	R41
V1	6BA6	V7
V2	6BE6	V6

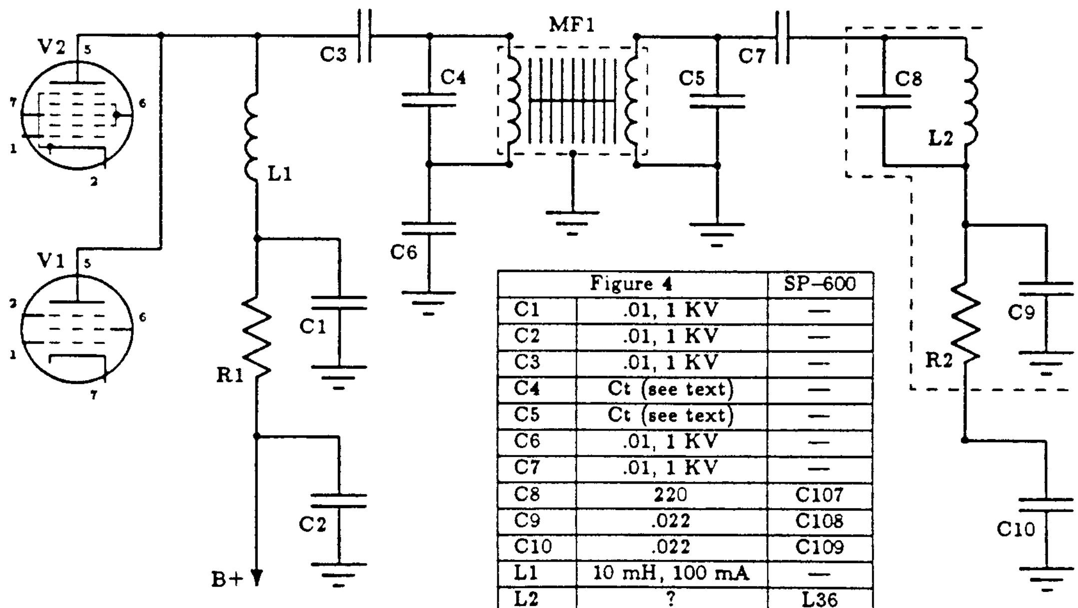


Figure 4		SP–600
C1	.01, 1 KV	—
C2	.01, 1 KV	—
C3	.01, 1 KV	—
C4	Ct (see text)	—
C5	Ct (see text)	—
C6	.01, 1 KV	—
C7	.01, 1 KV	—
C8	220	C107
C9	.022	C108
C10	.022	C109
L1	10 mH, 100 mA	—
L2	?	L36
MF1	see text	—
R1	2200	—
R2	2200	R41
V1	6BA6	V7
V2	6BE6	V6

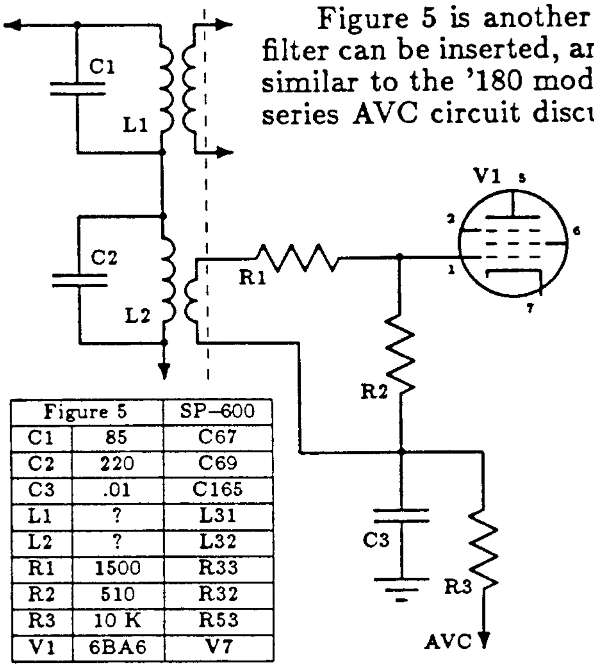


Figure 5		SP–600
C1	85	C67
C2	220	C69
C3	.01	C165
L1	?	L31
L2	?	L32
R1	1500	R33
R2	510	R32
R3	10 K	R53
V1	6BA6	V7

Figure 5 is another part of a SP–600 schematic where a mechanical filter can be inserted, and Figure 6 below shows the modification which is similar to the '180 modification in Figure 2. Figure 6 also illustrates the series AVC circuit discussed in Part 2 (*HSN* **12**). It requires a bit more "surgery" than the Figure 4 modification, but has the advantage (or disadvantage, depending on your point of view) of placing the mechanical filter immediately after the first mixer. Similar to the '180 modification, the Figure 6 modification provides mechanical filter selectivity only for the low bands, bands 1 – 3. I have not done the Figure 6 modification, so I do not know how difficult it may be to access the junction of L1-C1 and L2-C2. I would appreciate receiving a letter from any reader who does this modification concerning the difficulty or ease of accessing the junction of L1-C1 and L2-C2, and any other points about this modification so that I can include additional information in future revisions. Notice, too, that both R1 and R2 should be removed, and there should be no components connected to the output link coupling of L2 (L32). The Figure 6 modification is different from the '180 modification in another important way. In both cases, signal loss is intentionally introduced before the "gate" [V1 (V17) of Figure 1 and V1 (V7) of Figure 5] because an IF amplifier [which the "gate" essentially is] has more gain than a converter [which is used in place of the "gate" for the high bands signal path]. But the methods of introducing signal loss are different, cf. Figures 1 and 5. Having no direct experience with a SP–600, I do not know what effect the mechanical filter modification in Figure 6 will have on net signal level loss or gain for the low bands signal path. In other words, I cannot predict whether the sum of the mechanical filter insertion loss plus the gain from eliminating the impedance mismatch at the grid of V1 (V7) in Figure 5 will be positive or negative. In the best of all possibilities, the loss and gain would exactly cancel, requiring no further circuit changes. If the net effect is a loss, I will describe a simple solution later which is also applicable to the modification in Figure 4. If the net effect is a gain, then gain reduction should be applied to the gate, and I will describe a simple solution later which uses a circuit borrowed from the '180. Perhaps it is appropriate here to give an important ***WARNING***: impedance mismatching should never be used at either the input or output of a mechanical filter because it may [and usually will] cause all kinds of anomalous performance, including *greatly* increased insertion loss, possible spurious responses such as harmonic and intermodulation

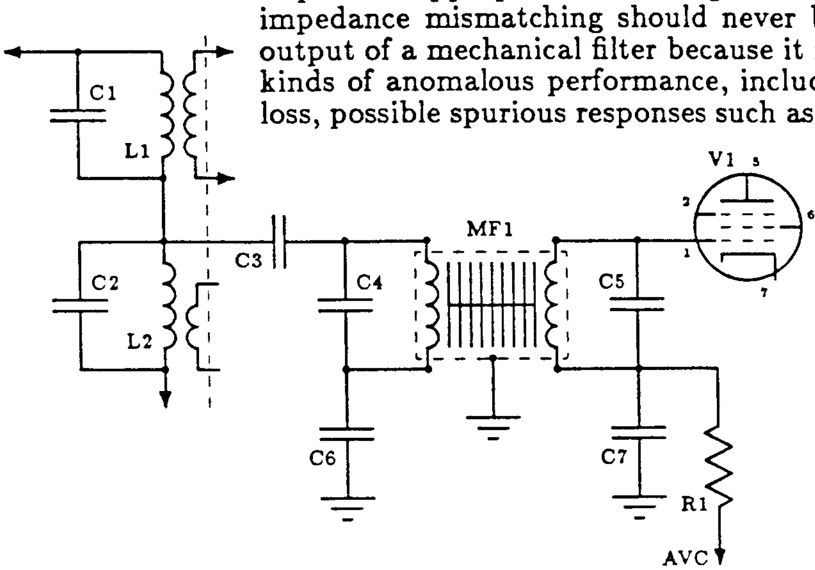


Figure 6		SP–600
C1	85	C67
C2	220	C69
C3	.01, 1 KV	—
C4	Ct (see text)	—
C5	Ct (see text)	—
C6	.01, 1 KV	—
C7	.01	C165
L1	?	L31
L2	?	L32
MF1	see text	—
R1	10 K	R53
V1	6BA6	V7

distortion, *greatly* increased pass band ripple, and *greatly* reduced stop band rejection. If the thought of removing and opening up T2 to find the junction of L1-C1 and L2-C2 blows your mind, not to mention the potential problem of rewiring T2 to bring a lead from the junction to a lug on the base of T2 so that you can access the junction, then you might like to consider an alternate approach below in Figure 7. As I have indicated above, the problem with connecting a mechanical filter between the grid of V1 and the junction of R1 and R2 of Figure 5 is the resulting impedance mismatch which would probably cause all sorts of anomalous filter performance. But did you know that FA and FB (and probably N) series mechanical filters can be tuned in two ways — parallel and series? The parallel tuning is generally found in most production circuits, and in fact I have never seen the series tuning used in practice (it is mentioned briefly in Collins data sheets for the FA and FB series filters). Parallel tuning is used for loads of 100 K ohms or more, which is perfect for tube plates and grids, and for high impedance parallel L-C circuits such as in the previous examples. Series tuning is used for loads of 500 ohms or less, which would seem ideal for the 510 ohm load presented by R2 of Figure 5. Never having tried it, I can make no promises for the modification of Figure 7. If anyone checks it out, please drop me a line.

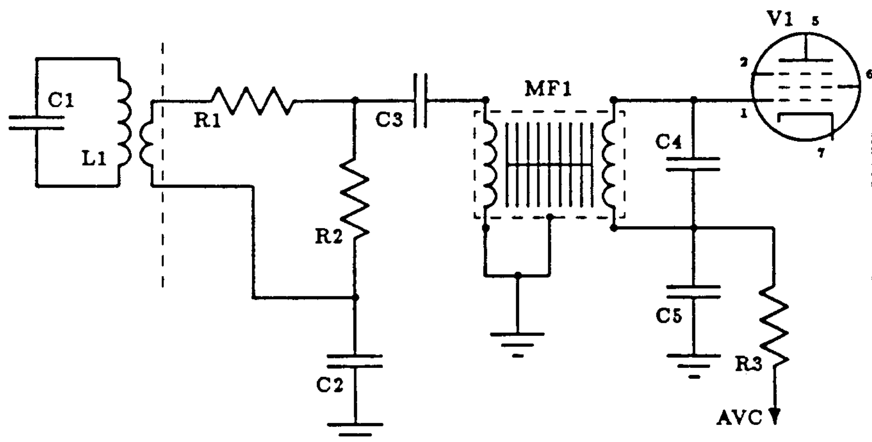


Figure 7		SP-600
C1	220	C69
C2	.01, 1 KV	—
C3	Ct (see text)	—
C4	Ct (see text)	—
C5	.01	C165
L1	?	L32
MF1	see text	—
R1	1500	R33
R2	510	R32
R3	10 K	R53
V1	6BA6	V7

As I said above, for the SP-600 there is a simple way to compensate for any reasonable (5-10 dB) insertion loss introduced by a mechanical filter. Figure 8 shows the method: unsolder the wire at the junction of R1 (R95) and R2 (R96), remove R2 (R96), and replace it with a 25 K, 2 W variable. The R1-R2 circuit is a voltage divider which provides about −10 VDC for the grid of V11, thus substantially reducing the gain of V11. This is the same principle used for AVC, except that the AVC voltage varies depending on signal level. Just as a guess, the modification in Figure 8b may permit an additional 20 dB gain from V11, which is much more than should be needed. The 25 K, 2 W variable resistor can be mounted almost anywhere you please as long as you don't run the connecting wire near RF, mixer, oscillator, and IF stages which precede V11 in the signal path. Because variable resistors are notorious for promoting anomalous performance as they age, the best approach is to replace R2 with two fixed resistors soldered in place.

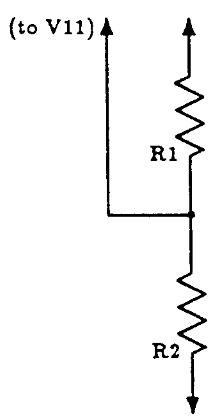


Figure 8a		SP-600
R1	82 K	R95
R2	22 K	R96

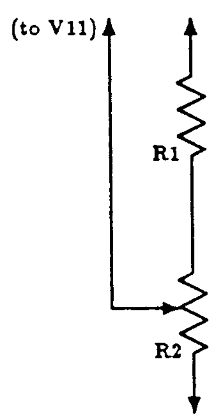


Figure 8b		SP-600
R1	82 K	R95
R2	25 K, 2 W	—

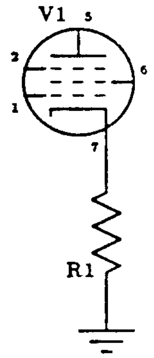


Figure 9a		SP–600
R1	390	R112
V1	6BA6	V7

The final circuit in this collection of SP–600 mechanical filter modifications is a gain reduction method for the "gate." Figure 9a shows the original V1 (V7) cathode circuit, which is similar to the method used in older '180's. Look back at Figure 2 and you will see that the circuit of Figure 9b is essentially the same as the one which works well in my '180 modification. The circuit in Figure 9b should allow up to 20 dB of gain reduction, i.e., about 3 S-units. Like the modification of Figure 8b, the best approach is to replace R1 and R2 in Figure 9b by a fixed resistor after the required value (180 ohms plus the experimentally determined value of R2) has been determined. The bypass capacitor C2 is desirable to minimize stray signal paths while both R1 and R2 are in use because it will probably be necessary to mount R2 some distance away from pin 7 of V1 (V7). At this point it is perhaps appropriate to say that the Figure 9b modification is intended for use only with the Figure 6 or Figure 7 modification, while the Figure 8b modification is intended for use only with the Figure 4 modification.

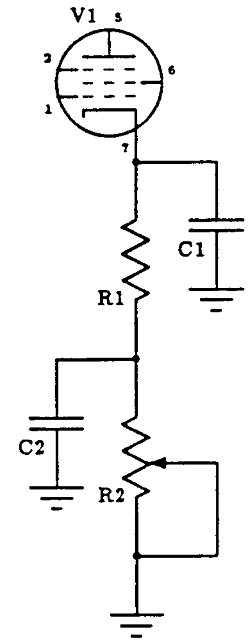


Figure 9b		SP–600
C1	.01, 1 KV	—
C2	.01, 1 KV	—
R1	180	—
R2	2500, 2 W	—
V1	6BA6	V7

There a several points to consider before you rush off and add a mechanical filter to your SP–600. First, which filter series and what band width will you choose? If you never listen casually, and only DX, then I suppose a 2 kHz band width filter is the logical choice. But I presume you have considered that a 2 kHz band width significantly reduces fidelity. A good compromise is a 4 kHz filter, which I used for my '180 modification, but I missed the wider band widths enough to have caused me to begin preparations for a switched mechanical filter arrangement for my '180. That is not as difficult as you might think, because an R–390A IF subchassis contains all the parts necessary for such a construction project. Second, you will not be able to use the SP–600 crystal filter narrow band widths (1.3, 0.5, and 0.2 kHz) unless its center frequency just happens to be very nearly 455 khz. To avoid an unpleasant surprise later, measure the crystal filter center frequency before you start . An off-frequency crystal filter will not stop the determined experimenter, who will trade crystals until the center frequency is acceptable. An R–390A IF subchassis contains a crystal filter with a 455 kHz crystal which may suffice. Third, where and how will you mount the mechanical filter and its associated components? In my experience it takes about the same amount of work to develop a satisfactory mounting arrangement for both the FA/FB and N series filters. In both cases be sure that a grounded metal shield is placed between the input and output terminals (including all associated components such as Ct's and leads. If it is not possible to isolate parts of the leads, double shielded cable may be required to avoid degrading filter stop band performance. Fourth, if you do the modification in Figure 6, give some thought to opening up transformer T2 for access to the junction of L1-C1 and L2-C2. Assuming T1 has a "quick release" shield style and there is enough nearby empty space, it may be possible to modify T1 *in situ*, without removing the entire transformer assembly from the chassis. But do not hesitate to remove the entire transformer assembly if it is necessary.

The HQ–150 is another receiver in the Hammarlund line which can be fitted with a mechanical filter. Figure 10a shows part of the first IF transformer (T1) and the AVC and input to V1 (V4). The '150 modification in Figure 10b is similar to the Figure 6 modification in that you will have to remove the IF transformer shield and rewire the output. I have not done this modification, but reports of a similar modification to a HQ–129 indicate that the increased signal level due to modifying L1 approximately compensates

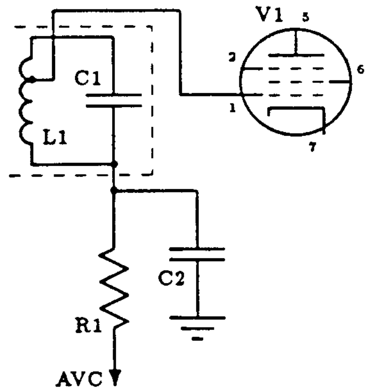


Figure 10a		HQ-150
C1	260	C11
C2	.02	C12
L1	?	not labeled
R1	10 K	R10
V1	6BA6	V4

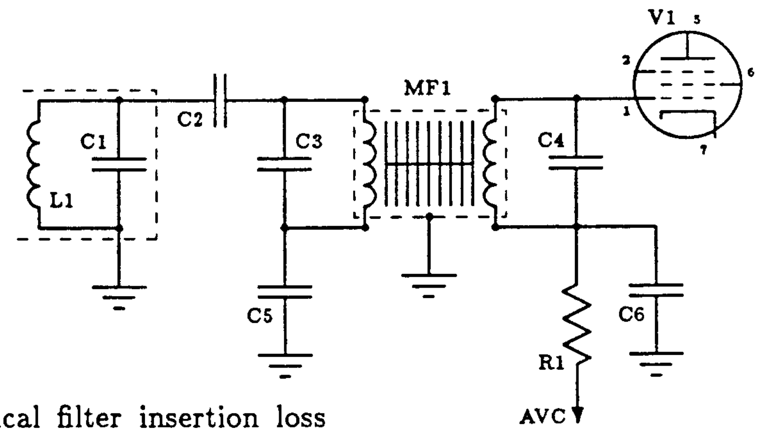


Figure 10b		HQ-150
C1	260	C11
C2	.01, 1 KV	—
C3	Ct (see text)	—
C4	Ct (see text)	—
C5	.01, 1 KV	—
C6	.02	C12
L1	?	not labeled
MF1	see text	—
R1	10 K	R10
V1	6BA6	V4

for mechanical filter insertion loss which should make additional modifications unnecessary. However, if a net signal level gain is experienced after adding a mechanical filter, the gain-reduction modification in Figure 9b may be used at the cathode of V1 (V4) in Figure 10b. And, if a net signal loss is experienced, the the inductor in T3 can be modified like L1 of Figure 10b. Apparently it may require modifications to both T1 and T3, and, in addition, a gain-reduction modification to the cathode of V1 (V4) to restore the '150 gain distribution.

PUBLISHER'S CORNER

So what does your intrepid publisher do when he gets the first draft? Well, obviously, I read it and try to find any spelling or other errors. I also make suggestions about style and layout. Then I write the Publisher's Corner, and return the draft to Dallas who produces a camera-ready copy. For this issue, the corrected and final draft arrived back in Ruston about October 14. When I receive the camera-ready copy several weeks later, I take it to Pioneer Printing on 36th Street and Eighth Avenue, Manhattan for prompt printing of 200 copies. Afterwards, I sort the mailing list in my company's computer, delete those whose subscription expired two issues before the current one, and send a personalized letter to those whose subscription expired with the previous issue. Then I print the address labels, collate and staple each copy, and attach labels to the envelopes which are also printed by Pioneer Printing, and are quite striking, I think. Next I stamp the envelopes, rubber-stamp the renewal issues, fold, insert, and seal each newsletter, and trek across Webb Avenue in the Bronx to drop 130 finished newsletters in a mailbox. Finally, I sit back, sip a Manhattan, and declare the job well-done.

Speaking of jobs well-done, Dallas asked me to thank the 10 – 15 individuals who responded during the month of September to our appeal for material. We are very pleased with the results. That doesn't mean that the rest of you can sit on your *tokuses*. We still need material if *HSN* is to continue to be published regularly. The current supply of material may be *barely enough* for winter and spring 1987 issues.