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Neutralizing Economy

Taking the d.c. off the Neutralizing Condenser

BY B. P. HANSEN,* W9KNZ

T. M. Ferrill's article in *QST* for December, 1938,[1] suggested a sensible means of effecting improved performance and economy in the plate tank tuning condenser in any final amplifier stage. There is no good reason why the same principles cannot be applied to the neutralizing condensers in the same amplifier. Many times, when the power input to a final amplifier is increased, it is found that the old neutralizing condensers are just a little too small, with the result that flashovers occur. Replacement with larger condensers is the obvious solution but not the only one — unless the increases in plate voltage and bias are considerable.

It is highly desirable that the physical dimensions of the neutralizing condensers be small from the standpoint of reducing stray capacitive coupling to parts of the circuit where it is not wanted.

Referring to Fig. 1, it will be seen that in the normal setup, the neutralizing condenser has a pretty heavy cross to bear. Across it, in series

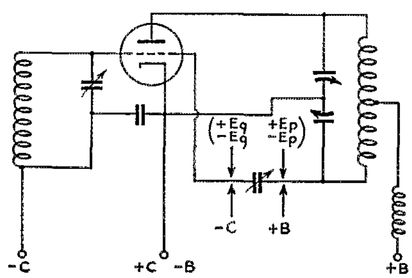

Fig. 1 **— Voltages pile up across the neutralizing condenser in conventional circuits, as shown in this drawing.**

adding, are the bias and d.c. plate voltages. Also across it in phase, are the grid excitation voltage and the r.f. voltage across the tank coil. If we can remove the d.c. voltages across this condenser, two things are accomplished; the r.f. voltage which can be applied across its terminals becomes much higher, and the damage that might result through the d.c. arc that usually holds after a flashover in a "mixed" circuit is prevented.

First, let's consider how to accomplish this improvement, then we'll see why it works.

Fig. 2 shows a more or less typical final amplifier using Ferrill's suggestion for the plate tank and employing d.c. isolation for the neutralizing condensers. C_x is a well-insulated mica condenser whose capacity is much larger than the capacity of the neutralizing condenser. If, for example, C_n is about 15 μμfd., a common value, then C_x might well be 0.001 μfd. rated at 5000 volts d.c. working voltage. Remember that the ratings of by-pass or blocking condensers depend to a great extent upon the voltage *drop* across them, not necessarily upon the values of the voltages impressed upon the circuits in which they are used. Because most of the r.f. drop in this circuit is across the neutralizing condenser, C_x has little work to do insofar as r.f. is concerned. Its purpose is to prevent the plate voltage from reaching the grids of the tubes. R_n, the value of which can be about one-half megohm, rated at one or two watts, effectively short circuits the neutralizing condenser insofar as d.c. is concerned, but has negligible effect upon the r.f. constants of the circuit.

Well, that's all there is to it. The effectiveness of the scheme is shown by the example of the W9KNZ transmitter. Economy dictated the choice of neutralizing condensers . . . economy and availability. In the conventional circuit, 1000 volts was the maximum that could be plate-modulated without their flashing. Now the old 242A's have to take 1750 and like it because

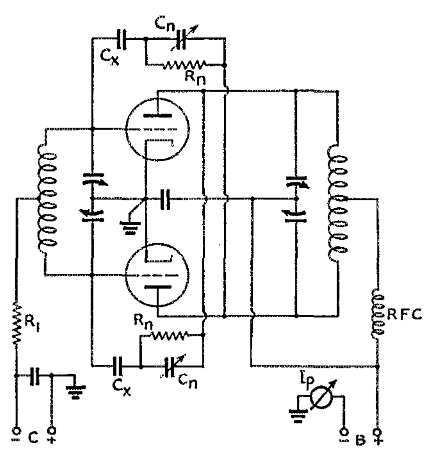

Fig. 2 **— The circuit arrangement used by W9KNZ brings both sides of the neutralizing condenser to the same d.c. potential but does not disturb r.f. conditions. C_n handles the r.f.; C_x the d.c.**

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[1] Ferrill, "How Much Condenser Spacing?" *QST*, December, 1938.

the neutralizing condensers no longer flash over. This is good, sound (!) typical ham reasoning. If the amount of soup that can be poured into the old rig is limited by any single circuit component, fix that one thing up and pile on the soup till something else breaks down. HI! This stunt is finding application in at least one broadcast station and several others have inquired about it. Since new regulations have called for power reductions in some stations, changed operating conditions have, in occasional cases, resulted in increased peak voltages, believe it or not, and the first place that trouble seems to occur is in the neutralizing condensers. Something has to give!

Here's the why: Condensers are often connected in series in order to increase the breakdown voltage rating of a given filter setup. Now, the d.c. voltages across condensers in series do not divide inversely as the capacities, the laws of physics to the contrary. This is because the d.c. voltage drop across a condenser tends to be proportional to the leakage resistance of that

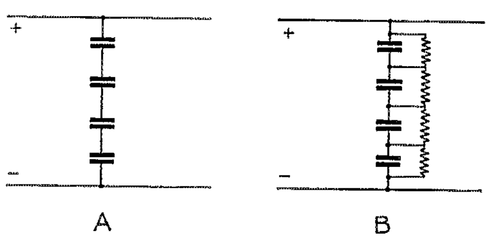

Fig. 3 — **Equalizing voltages across series-connected filter condensers by means of high resistances.**

particular condenser. To prevent disaster in filter setups where condensers are used in series, small bleeder resistors of equal value are placed across each condenser as shown in Fig. 3B. These resistors are of low enough value to swamp out variations in leakage resistance and thus the actual d.c. voltage across each condenser is made the same. C_n is an air condenser and thus its leakage resistance is extremely high. C_x, in series with C_n, is a mica condenser whose leakage resistance is also very high but not as high as that of C_n. Therefore, although the d.c. path through C_n is apparently broken by C_x, really the CHARGE across C_n is practically the same as before and the mere insertion of C_x does not prevent flash-over. Now we place R_n across C_n, thus bringing its leakage resistance to a low value compared to that of C_x. This places the full sum of bias and plate d.c. voltages across C_x.

This suggestion may not appeal to the fellow who can spend all he wants to on his rig. But to the fellow who has to pull most of his stuff out of the junk box, it should prove interesting. As a cure for an existing case of trouble it is much more economical than the purchase and installation of larger neutralizing condensers. Because the physical dimensions of the condensers are smaller than those that would otherwise be required, the scheme possesses technical merit aside from its economy. The reader is referred to Ferrill's article for examples of plate spacings for given operating voltages. Keep in mind that the excitation voltages and r.f. plate voltages at any instant are across the neutralizing condenser

Neutralizing condensers have a tendency to flash over? Here's a simple way to isolate the d.c. and thereby lower the peak voltage the condenser must handle. Inexpensive, too.

William H. Smith, Ex-9ZF, 9KOA

Amateur radio lost one of its beloved old timers with the death on November 18, 1939 of William H. Smith, of Denver, Colo., undoubtedly the most enthusiastic "wireless" pioneer in what is now the Rocky Mountain Division.

One of the organizers and charter members of the Colorado Wireless Association, Denver's first radio club, "Pop" Smith was chief operator during its entire existence, 1912 to 1922. He used the familiar letter "S" as his call from his beginning in amateur radio until about 1915, when the limited commercial call "KIX" was assigned to him as the Denver communications office of a Colorado mining company. During the war he taught code classes at the Y.M.C.A., and afterwards he again became active with a 1-kw. rotary quenched spark outfit using the call 9KOA which was issued to him at that time. From that station he broadcast time signals nightly, and many amateurs will remember the astonishing accuracy with which they were sent, even though transmitted manually. Confirmations of reception were received from listeners more than 2000 miles distant. All of his apparatus was home-made — exact duplicates of the best manufactured equipment of the day.

"Pop" Smith was the first amateur in Colorado to make out-of-state contacts, quite an achievement back in the 1916 spark days. One of the first League members, and for several post-war years a director, he was active in organizing the A.R.R.L. trunk lines. Operating 9ZF in the first transcontinental relays, he successfully bridged the long gap between 6EA, Los Angeles, and 9ABD, Jefferson City, Mo. He remained active until spark was outlawed and never operated c.w., but was a constant listener to all branches of radio services up to the time of his death.