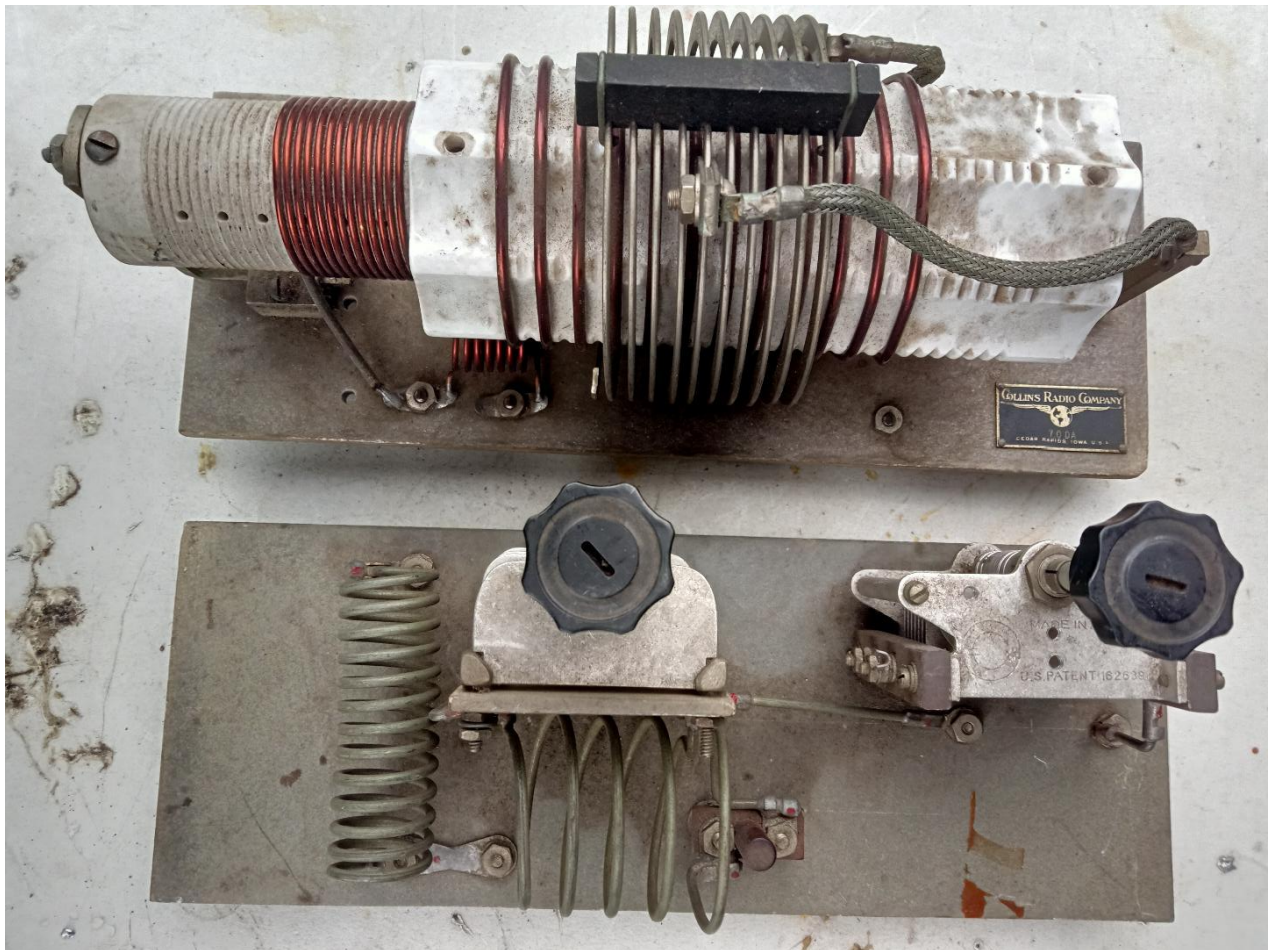


Lab Report: Neutralization

Andy Thomas G0SFJ

25 March 2026

I came across these two assemblies recently – those of you who know what they are, Keep Silent at the Back! This is the story of how I found out.

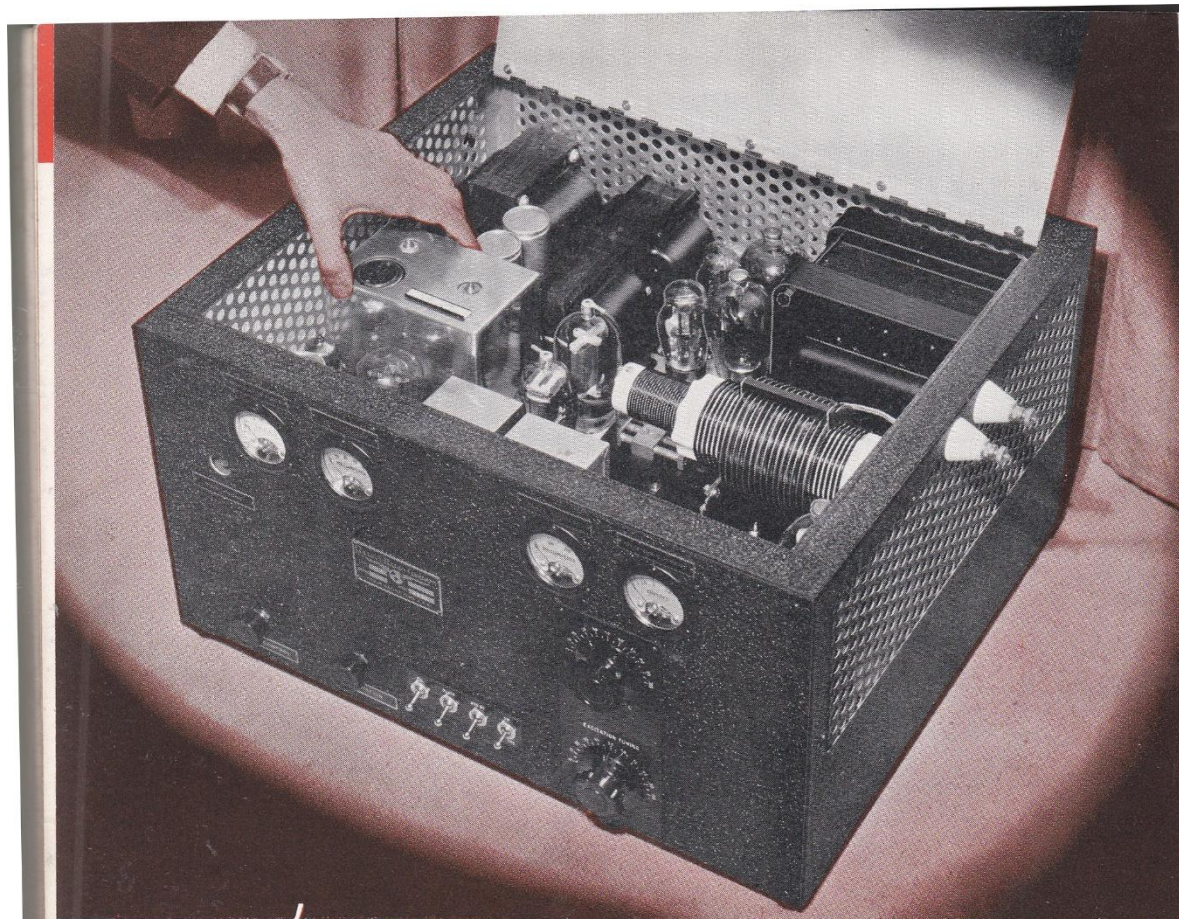


I bought the top one first, thinking it was a Hartley oscillator coil – it isn't. Then I came back for the second one. I thought it was an ATU – it isn't.

The first clue is here:



Well, there is an excellent collectors' site maintained by Collins radio fans (<https://collinsradio.org/>) and although I didn't find 7.0 DA (perhaps it's a serial number?) soon I found the 1934 transmitter type 45A. Here's an advert from 1936.



The Accepted Standard of Excellence

the 45A transmitter, a high-performance, low cost transmitter is illustrated above. The various COLLINS models and new developments are described currently in a technical bulletin and catalogue, the COLLINS SIGNAL. A post card will serve to place your name on the mailing list without obligation.

Amateurs the world over know by experience that each COLLINS transmitter is not only a beautiful piece of apparatus, but also that its clever design and skillful construction result in greater output, clearer signals and more reliable operation.

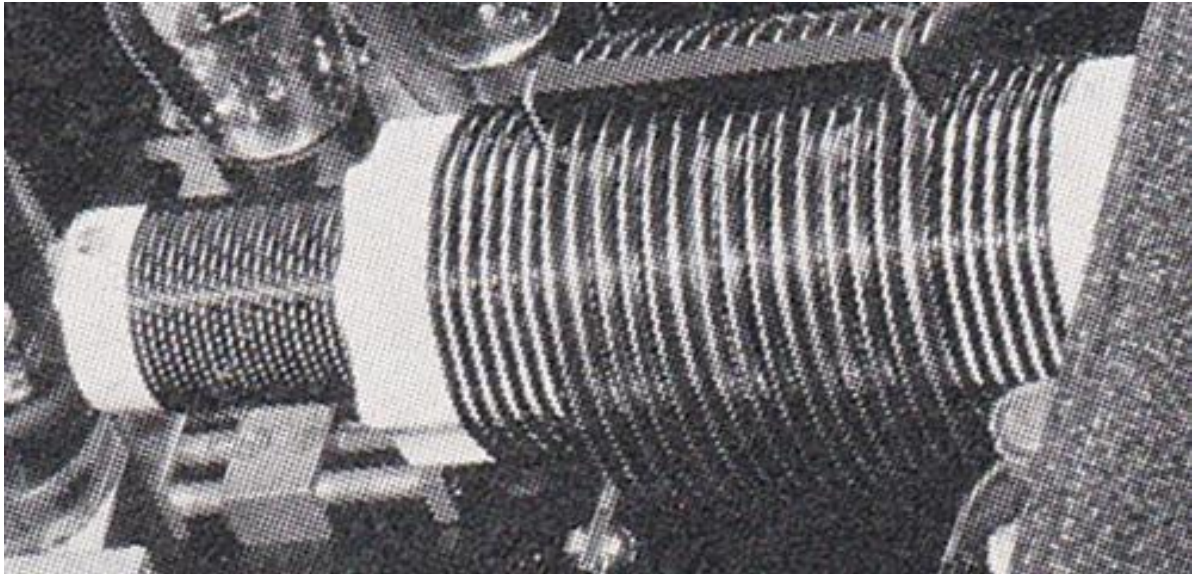
There is no surer, less costly way to get real results, than to make a complete COLLINS installation.

Collins Radio Company

CEDAR RAPIDS
New York
11 West 42nd St.



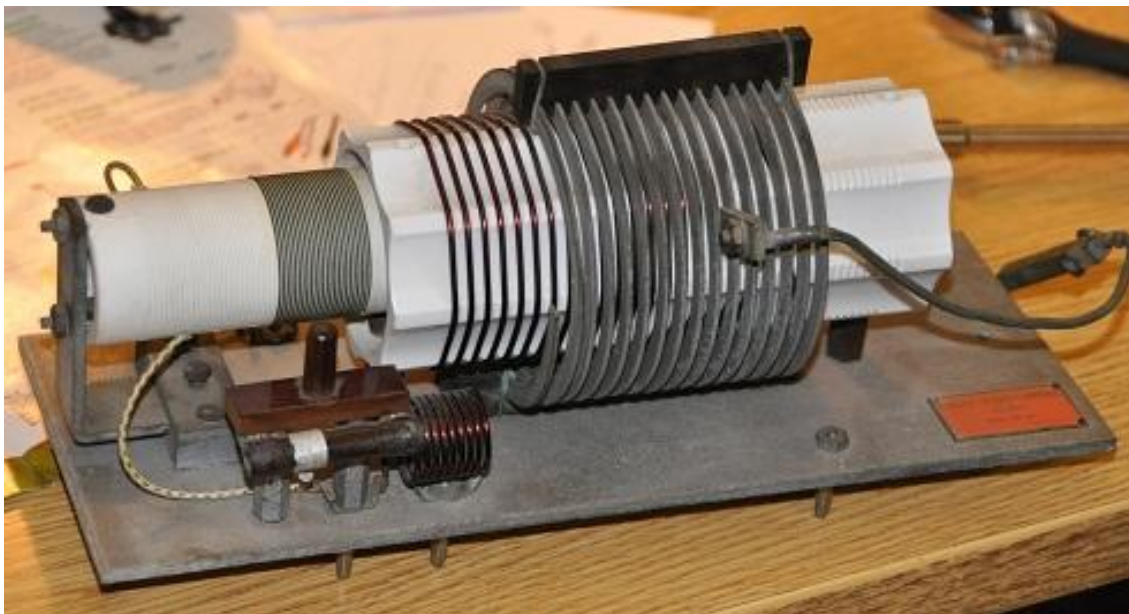
IOWA, U. S. A.
Mexico City
Edificio "La Nacional"

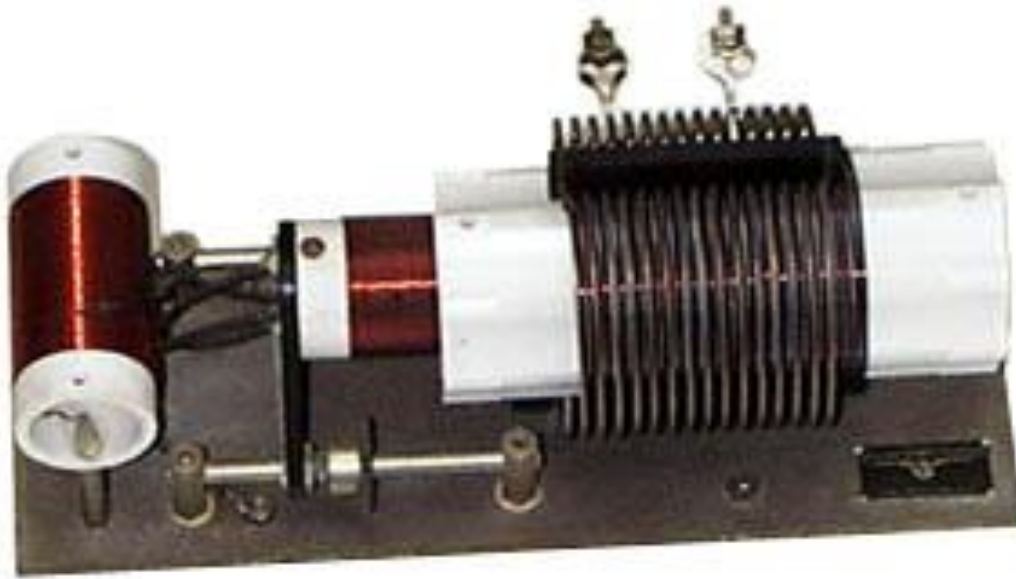


ARRL Radio Amateur's handbook, 1936 edition

A close-up of this device is shown above. According to the Collins brochure <https://collinsradio.org/wp-content/uploads/2012/12/45Abroch3.jpg> , it's a unique form of low-loss neutralisation using inductance only.

Here are other close-ups from the Collins site.





<https://collinsradio.org/cca-collins-historical-archives/the-equipment-of-collins-radio/historical-equipment/45a/>

This Collins set was the Bees-Knees of transmission in the mid 1930s. Here's a testimonial from a Harvard University/MIT expedition to the Urals (USSR):

RESEARCH
LABORATORY
OF PHYSICS

THE PHYSICS LABORATORIES
HARVARD UNIVERSITY
CAMBRIDGE MASSACHUSETTS

September 15, 1935

Mr. Arthur A. Collins
Collins Radio Company
Cedar Rapids, Iowa

Dear Mr. Collins:

You will doubtless be interested in the following report of the performance of the 45A transmitter which was used on the Harvard University-Massachusetts Institute of Technology eclipse expedition.

Our geographical position was most unfavorable for United States signals, since they had to pass near the north magnetic pole. As a result, even the high-powered commercial stations were audible less than an hour each day. This made it impossible for us to communicate regularly direct with the United States. One fone and five cw contacts with the United States were all that were made during the months of operation. However, the transmitter was used a very great deal sending traffic to England and Sweden, whence it was relayed to the United States. Reliable schedules were set up and considerable traffic handled. Nearly all this was done on fone, as it was possible to cover all of Europe with a 85 to 90 fone signal on 14 mc. During our efforts to establish satisfactory traffic routings, contacts were made with amateurs in 26 countries and all continents except South America. Our call, URAD, was very well known in Europe by the time we left.

We were frequently complimented on the good quality of our voice reproduction. In many cases the transmitter was identified as a "Collins job" before we mentioned it, largely for this reason. The 45A transmitter seems to be widely and favorably known among the European operators.

We found the plug-in coil arrangement very handy, particularly the inclusion of the antenna coupling coil in the plug-in section. The inductive neutralization was found to be stable and easy to adjust.

The ease with which we could communicate with the "outside world" was a great convenience and satisfaction to those of us on the expedition.

Yours truly

H. Selvidge

H. Selvidge
Instructor in Communication Engineering

HS:A



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We were frequently complimented on the good quality of our voice reproduction. In many cases the transmitter was identified as a "Collins job" before we mentioned it, largely for this reason. The 45A transmitter seems to be widely and favorably known among the European operators.

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Yours truly
H. Selvidge
H. Selvidge
Instructor in Communication Engineering

HS:ck

URAD

★

AN INTERESTING
LETTER ON THE PER-
FORMANCE OF THE
45A AT AK-BULAK IN
THE KAZAK REPUB-
LIC, NEAR OREN-
BURG, U. S. S. R.

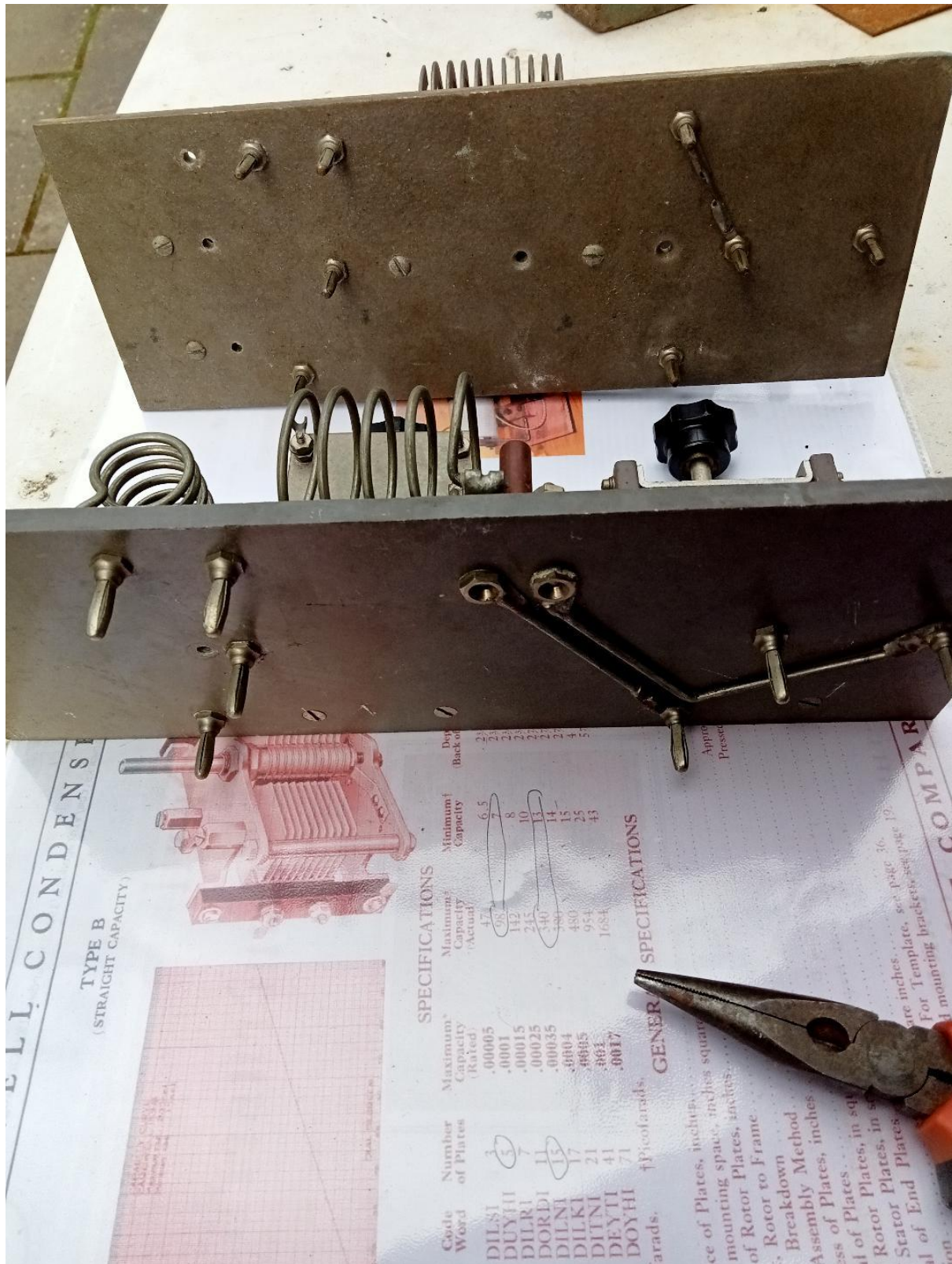
★

Collins Radio Company

CEDAR RAPIDS IOWA, U. S. A.
New York Mexico City
11 West 42nd St. Edificio "La Nacional"

https://collinsradio.org/wp-content/uploads/2012/08/45A_1-37.jpg

I noticed that the second assembly also rested on 4mm pins in the same configuration, from which I deduce that it's supposed to fit in the same bay as the Collins invention above.



Tracing the assembly connections would start to rebuild the circuit diagram of the final stage. (It's still work in progress)

This second assembly is a twiddly one with two different variable capacitors. They have the same US patent number, 1626391:

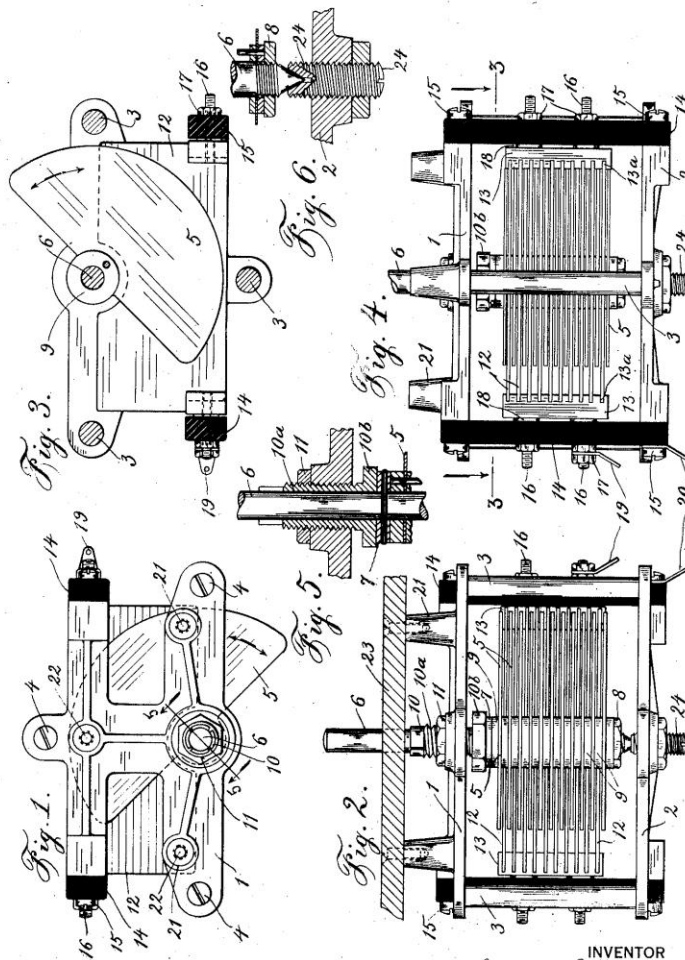


and I found it:

April 26, 1927.

A. D. CARDWELL
VARIABLE AIR CONDENSER
Filed Sept. 26, 1922

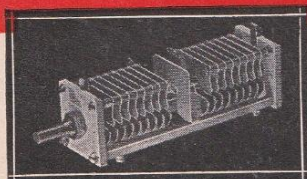
1,626,391



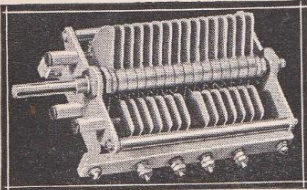
INVENTOR
Allen D. Cardwell
BY *T. P. Brown*
his ATTORNEY

Cardwell still produce quality electronic components – of course these ones date from about 1934/6. An advertisement for 1938 shows their range:

CARDWELLS *for every purpose*

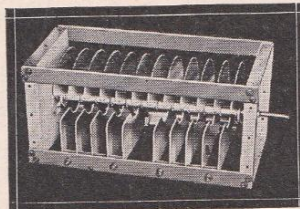


★ **Trim-Air MIDGET DUAL**
Singles and duals for receivers, exciters and L.P. Transmitters.



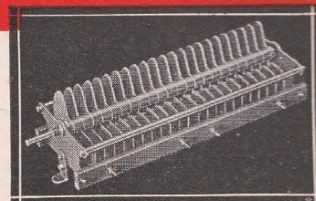
★ **Midway Featherweight**
Builder's choice for buffer stages—medium power finals.

TYPE "P" LIGHT WEIGHT CONDENSER FOR COMMERCIAL AND AMATEUR HIGH POWER TRANSMITTERS

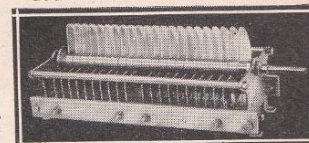


GENERAL SPECIFICATIONS ON "P" TYPE CARDWELLS

END PLATES—Stamped and folded $\frac{1}{8}$ " aluminum $7\frac{1}{2}$ " square, satin finish. **MOUNTING**—On any side. **ROTOR CONTACTS**—Heavy disc double finger wipers on each end of condenser. **INSULATION**—High frequency G. E. mycalex. No metal tie rods. **ROTOR PLATES**—.0625" thick, $6\frac{3}{4}$ " diameter, buffed and polished aluminum.



★ **"X" TYPE**
Transmitting Condensers
Airgaps to .200"—single and dual sections—all capacities.



★ **"T" TYPE**
High Power Condensers
Airgaps to .500"—For complete listing, send for Catalog No. 40.

DISC TYPE NEUTRALIZERS



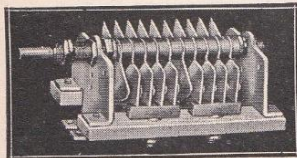
Type ADN, capacity range .5-4 mmf.
List\$3.00
Dealers' Price 1.80

TYPE BDN, for high power.
Capacity 2-12 mmf.
List\$5.00
Dealers' Price 3.00
Alsimag No. 196 insulation throughout.

Satin finish aluminum—fine screw adjustment, no wobble. Knurled thumb nut for easy locking—nickel silver bearing.

ULTRA HIGH FREQUENCY DUALS

FOR 5 AND 10 METER TRANSMITTERS AND DIATHERMY MACHINES

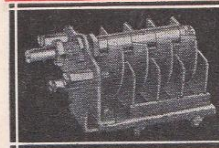


NP-35-ND

Widely used for ultra H. F. power oscillators and amplifiers; 5 and $2\frac{1}{2}$ meter radio transmitters, and 6 meter diathermy sets. No closed metallic loops—lowest losses. Insulation Isolantite.

Type	Per Section			Air Gap	Insulation	Depth Back Panel	List Price	Dealers Price
	Max. Cap.	Min. Cap.	Nr. Pits.					
NP-35-ND	35	5	9	.084"	Isolantite	4 1/8"	\$6.00	\$3.60
NP-35-DD	Same as above except unbuffed						5.35	3.21

H. F. NEUTRALIZING CONDENSERS



High frequency neutralizers for low capacity tubes. Mycalex insulation; heavy buffed plates with rounded edges. 180 degree rotation permits calibration and reset.

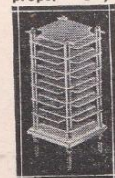
NA-16-NS

Type	Max. Cap.	Min. Cap.	Nr. Plates	Air Gap	Depth Back Panel	List Price	Dealers Price
NA-4-NS	4	2.5	2	adj.	1 3/8"	\$3.60	\$2.16
NA-6-NS	6	4	3	.218"	1 3/16"	3.60	2.16
NA-10-NS	11	6	6	.218"	2 1/8"	4.50	2.70
NA-16-NS	16	7	8	.218"	2 9/16"	5.00	3.00
NA-12-ND*	12	6	7	.218"	5 25/32"	15.00	9.00

* Ganged neutralizer with insulated coupling; Information given is per section.

PLUG-IN FIXED CONDENSERS

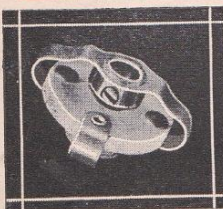
TYPE "J" PLUG-IN FIXED AIR CONDENSERS for boosting a tank circuit designed for 20 and 40 meters to 80 and 160. Just plug-in proper "J" unit into Jack Base and load tank to proper "C", for the lower frequencies.



Type	Capacity mmf.	Air-gap	Length	List Price	Dealers Price
JCO-50-OS	50	.250"	5 3/8"	\$5.50	\$3.30
JCO-25-OS	25	.250"	3 3/4"	4.00	2.40
JD-80-OS	80	.125"	4" ...	5.50	3.30
JD-50-OS	50	.125"	3 3/16"	4.00	2.40
JD-25-OS	25	.125"	2 1/2"	2.80	1.68
JR-750-OS	750	.030"	4"	8.80	5.28

All "J" types are $2\frac{1}{4}$ inches square.
TYPE JB—Jack Base for "J" fixed units. Alsimag 196— $2\frac{3}{8}$ " x $2\frac{3}{8}$ " x $\frac{1}{4}$ ". Complete with mtg. posts, screws and nuts, list\$1.00
Dealers' Price.....\$.60

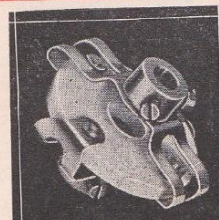
CARDWELL FLEXIBLE COUPLINGS



Type "A"

Type B is the same as type A except that the hubs are reversed to give maximum flashover. Price same as "A".

TYPE A—Fits all $\frac{1}{4}$ " shafts. Has isolantite insulation with new type nickel plated phosphor bronze springs and reversed brass hubs. Minimum space required. Maximum flexibility with no back lash. A real improvement over existing types. Overall diameter $1\frac{1}{2}$ ". Overall width outside hub-to-hub $\frac{5}{8}$ ". Packed in standard cartons of one dozen. List price\$.60 each
Dealers' Price.....\$.36 each



Type "E"

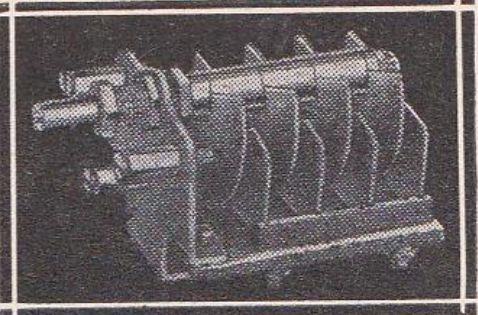
TYPE "ENF"—Lo-Flex rigid—10,000 V., $1\frac{1}{2}$ " iso. disc.

A heavy duty unit for high power variable air condensers or other rotary R.F. units. Insulation—No. 196 Alsimag disc $1\frac{1}{2}$ " diameter, $\frac{1}{4}$ " thick. Special steel cup set screws, heavy N.P. brass hubs, permanently staked into thick nickel plated phosphor bronze springs. Removable bushings to fit $\frac{1}{4}$ " shafts. Hubs fit $\frac{3}{8}$ " shafts with bushings removed.
List Price\$1.50
Dealers' Price90
insulated coupling $\frac{1}{4}$ " shafts only
List \$1.00. Dealers' Price, \$.60

THE ALLEN D. CARDWELL MANUFACTURING CORPORATION
83 PROSPECT STREET
BROOKLYN, N. Y.

Of great interest is this section of the advertisement:

H. F. NEUTRALIZING CONDENSERS



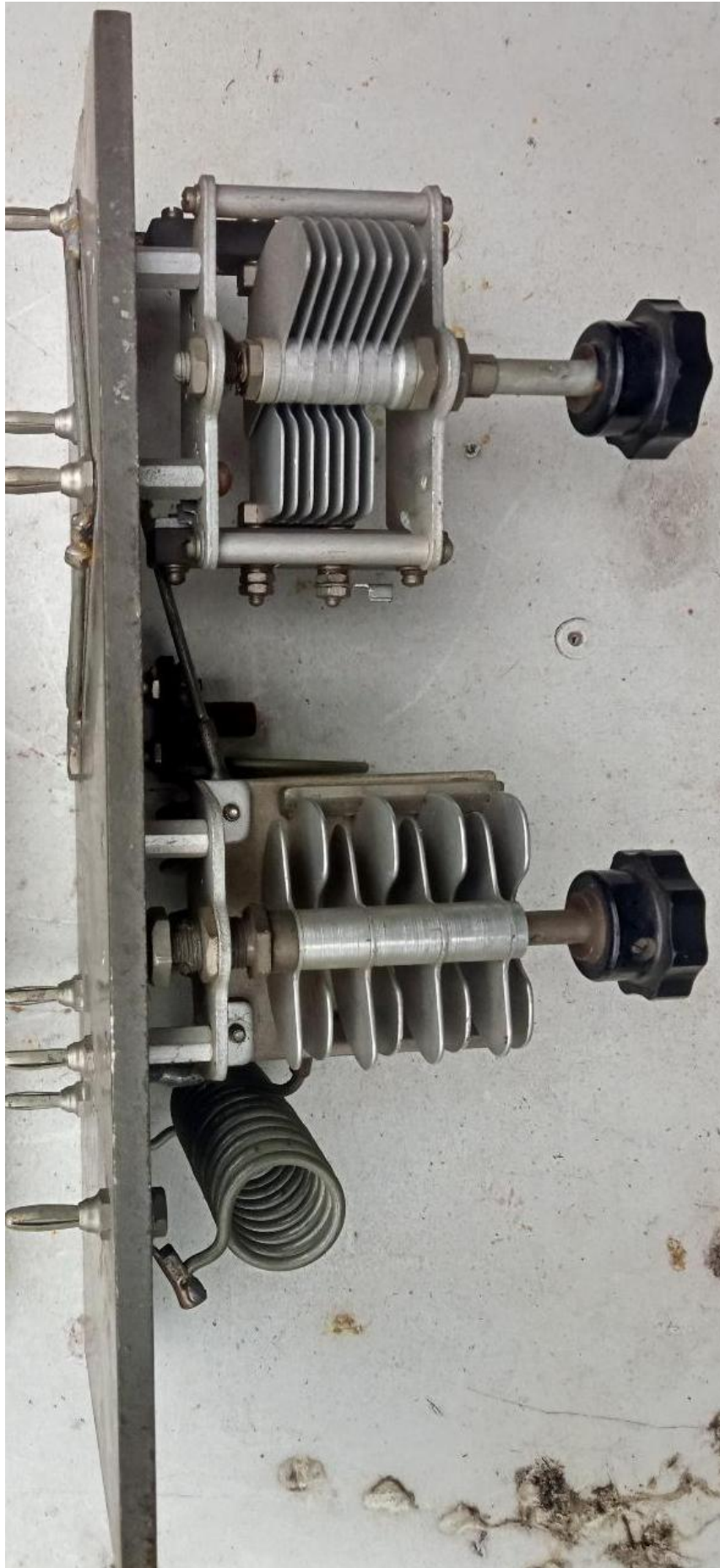
High frequency neutralizers for low capacity tubes. Mycallex insulation; heavy buffed plates with rounded edges. 180 degree rotation permits calibration and reset.

NA-16-NS

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NA-6-NS	6	4	3	.218"	1 3/16"	3.60	2.16
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NA-16-NS	16	7	8	.218"	2 9/16"	5.00	3.00
NA-12-ND*	12	6	7	.218"	5 25/32	15.00	9.00

* Ganged neutralizer with insulated coupling; Information given is per section.

This is the same structure as the one on the left-hand side of the second item. That's got 8 plates, so its range is between 7 and 16 pF.



Now let's see what it's for.

It deals with the tendency of the triode amplifier to oscillate by feedback due to the capacitance between the anode and the (controlling) grid within the valve (tube).

The 1992 ARRL handbook (pp15:21 to 22) remarks that "Depending on the inner electrode capacitances of tubes, a neutralization circuit may be necessary". According to *the 1938 ARRL handbook* (pages 155 ff), "Trouble is sometimes experienced in getting a triode amplifier completely neutralized". 1992 handbook: "the neutralization circuit energy cancels the unwanted in-phase (positive) feedback." Neutralization is carried out by finding the null in the feedback RF current.

The RSGB's 1968 *Radio Communication Handbook* (page 8.44) notes that "Neutralisation should be carried out at the highest frequency on which the amplifier is to operate" which explains the static nature of the unique Collins assembly.

The power amplifier valve ("tube") in the Collins 47A was a C-211-D. Let's look at the plate-to-grid capacitance of this valve...and the value is...12.5 pF, smack in the middle of the range of the Cardwell capacitor. (The RCA model was 14 pF but still within range).

https://www.radiomuseum.org/tubes/tube_211d.html

GENERAL CHARACTERISTICS		
Filament:		
Voltage	10	volts
Current	3.25	amperes
Amplification Factor	12	
Grid to Plate Transconductance at 100 ma.	4500	micromhos
Direct Interelectrode Capacitances:		
Grid to Plate	12.5	$\mu\mu\text{f}$
Grid to Filament	5.5	$\mu\mu\text{f}$
Plate to Filament	3.0	$\mu\mu\text{f}$

<http://frank.pocnet.net/sheets/111/2/211D.pdf>



211

POWER TRIODE

211

GENERAL DATA

Electrical:

Filament, Thoriated-Tungsten:

Voltage. 10 ac or dc volts

Current. 3.25 amp

Amplification Factor 12

Direct Interelectrode Capacitances:

Grid to Plate. 14 μf

Grid to Filament 5.4 μf

Plate to Filament. 4.8 μf

<https://www.r-type.org/exhib/acf0047.htm>

CONCLUSION

So, there we have it. If you happen to have a valve-based power amplifier with a C-211D in its final, then this would have been an absolutely essential piece of kit.

It seems a shame to strip it down, so I will fit 4mm sockets to the plugs and see if I can use either assembly as some kind of ATU...

73 de Andy G0SFJ