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DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS
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SPECIFICATIONS FOR RADIO FREQUENCY INDICATOR, TYPE B.

This is a revision of the original specifications issued May 23, 1924. It represents the results of experience with a number of frequency indicators made with these specifications as a basis.

The frequency indicator described in these specifications is a device used in a radio transmitting station to indicate that the transmitting frequency is a certain predetermined value. It is essentially a one-point wavemeter. When the deflection instrument of the frequency indicator gives maximum deflection for the pointer set at the fiducial mark on the top of the device, the transmitting set is known to be operating at the frequency to which the frequency indicator is adjusted. This frequency must be the assigned frequency of the transmitting station.

These frequency indicators are found to be useful for the purpose mentioned in the following resolution of the Second National Radio Conference (March, 1923), "Every broadcasting station shall be equipped with apparatus such as a tuned circuit coupled to the antenna and containing an indicating instrument or the equivalent for the purpose of maintaining the operating wave frequency within two kilocycles of the assigned wave frequency."

Radio frequency indicators of the type designated as Type A in preliminary specifications of the Bureau of Standards, dated August 2, 1923, are in use in a number of the large broadcasting stations. Both the type A, and the type B described herein, were designed specifically for frequencies in the broadcast range, 550 to 1500 kilocycles. The type B frequency indicator embodies a number of improvements over the type A.

The Type B frequency indicator consists of a simple series capacity and inductance circuit with a thermogalvanometer inductively coupled to it. The main circuit includes a main coil, an auxiliary coil with 23 turns for the purpose of calibration, a 0.0005 fixed mica condenser, a 2-plate variable air condenser, a thermogalvanometer with coupling loop and a shield enclosing the complete frequency indicator. The proper number of turns on the main coil is given in Table 1 for the frequency nearest to that at which the frequency indicator is to be set. Constructional details of the frequency indicator are shown in blueprints, Radio Nos. 970-A, B and C. The auxiliary coil is provided with a surplus of wire so that adjustment to the exact frequency can be made in the calibration process by removing a portion.

The instrument is more rugged and yet more sensitive electrically than the Type A, is less subject to possible frequency changes, is more easily calibrated and set, and is shielded against effects from nearby metal objects. Means are provided to enable the station operator to make the final adjustment to resonance by a variation in the frequency indicator rather than in the transmitting set. This is accomplished by means of a very small variable air condenser in parallel with the main condenser in the frequency indicator. This also permits observation of the direction of shift in the transmitting frequency if it becomes slightly off its proper value. After the frequency indicator has been calibrated a white line is placed opposite the pointer attached to the movable plate of the 2-plate condenser. When the thermogalvanometer gives maximum deflection with the pointer at the white line, the station is operating on the frequency for which the frequency indicator is set.

Main Coil.-- The main coil is wound on a substantial tube (1) made of a good grade of insulating material. This tubing is 17.77 cms (7") long by 9.54 cms (3 3/4") outside diameter. The wall should not be over 0.635 cm (1/4") thick and not less than 0.317 cm (1/8") thick. Starting 0.635 cm (1/4") from the end, this tubing is threaded with a 0.079 cm (1/32") x 0.079 cm (1/32") thread with 12 threads per 2.54 cms (inch). The total number of threads will be determined by the number of turns to be put on the coil which is determined by the particular frequency to which the frequency indicator is to be adjusted. The proper number of turns may be found from Table 1. The frequency nearest that required can be found in column 1. The proper number of turns will then be found opposite this frequency, in column 2. The coil should be tightly wound with the proper number of turns. No. 16 A.W.G. (American Wire Gage) bare copper wire should be used. A single groove 0.079 cm (1/32") x 0.079 cm (1/32") should be cut 3.18 cms (1 1/4") from the last thread. This is to contain the single turn of No. 16 A.W.G. wire which is used for coupling the thermogalvanometer to the tuned circuit. No form of varnish, shellac or paint should be put on the completed coil at any time.

Auxiliary Coil.-- This coil is used during calibration to facilitate in setting the indicator to indicate the required frequency. Details of this coil support are shown in blueprint Radio No.970-B. This coil is wound in a flat spiral one turn thick. It is important that the flat disc (4) which determines the width of the slot in which this coil is wound be exactly 0.135 cm (0.053") thick. This coil is started on a 3.81 cms (1½") core. It should be tightly wound with 23 turns of No.18 A.W.G. double cotton covered copper wire. It should be wound in such a direction that when the inner end is connected to the nearest end of the main coil, both coils will have been wound in the same direction. The other end of this coil should pass through the nearest slot and fasten under the nut (22) on the lower end of the supporting bracket. This nut is the only one which should not be soldered during manufacture. It is soldered later as the final step of the calibration process.

Resonance Indicator.-- The indicating device (28) is coupled to the rest of the circuit by means of a single turn around the insulating tubing. This turn should be 3.08 cms (1 3/16") from the end of the main coil. The indicating device should consist of a portable type of radio-frequency thermogalvanometer. It should have full scale deflection for a current not greater than 125 milliamperes and a resistance of not over 8 ohms. The metal case of this instrument should be grounded to the shield.

Two-Plate Variable Air Condenser.-- The variable air condenser should be of good design electrically and mechanically. The two bearings should be closely fitted so that the shaft has neither vertical nor horizontal play. It should not develop such defects in the course of reasonable use. The fixed or movable plate should not be subject to warping or sagging. It is important that the movable plate be connected to the shield and that the fixed plate be insulated from the shield. Details of a type of construction to accomplish this purpose are shown in blueprint Radio No.970-B. The clearance between fixed and movable plate should not be greater than 0.317 cm (1/8")nor less than 0.159 cm (1/16"). The condenser plates should be stamped from material at least 1/32" thick and have a diameter of at least 6.03 cms (2 3/8").

If a variable air condenser of the type indicated on the blueprint Radio No. 970-B having stops is used, it is imperative that the movable plate be rigidly fastened to the condenser shaft, to guard against shifting the relative position of the movable plate and the pointer and thus destroying the calibration.

The two-plate variable air condenser is equipped with an insulating knob and metal pointer as shown at 7 on blueprint Radio No. 970-B. The knob and pointer are fastened to the shaft of the condenser by a set-screw and a steel pin which prevents the knob and pointer turning on the shaft and thus destroying the calibration. It is important that the steel pin be used, since set screws are liable to permit shifting of the knob on the shaft.

The pointer should be so fastened on the shaft with respect to the movable plate that when the latter is moved entirely away from the fixed plate, the pointer indicates "HIGH." This is the position for minimum capacity of the variable condenser.

Fixed Condenser.-- Since this device is a part of the circuit to be calibrated, a change in capacity will impair the calibration of the completed frequency indicator. Small cheap condensers are not to be considered for this purpose. The condenser must be of sound mechanical construction and of a type which will permit firmly mounting to the panel of the frequency indicator. The condenser terminals should be rigidly mounted so that there is no possibility of strain when attaching connecting wires. A condenser equipped with soldering terminals should not be employed unless it is definitely known that the heat can not injure the dielectric or the plates. One terminal

of the condenser is connected to the frequency indicator shield. This terminal may also be the metal case of the condenser.

The following list of condensers, although by no means conclusive, will serve as an example of condensers meeting the requirements just given:

Faradon mica condenser casing No.13 UC-1858, or casing No. 23 UC-2249, Wireless Specialty Apparatus Co., Boston, Mass.

Dubilier pattern No.128 mica condenser, Dubilier Condenser & Radio Corporation, 48 W.4th Street, New York, N.Y.

Mounting.-- The coil, thermogalvanometer, fixed condenser, and 2-plate variable air condenser should be substantially mounted on a panel of a good grade of insulating material. All nuts, except the nut at the end of the support terminating at the center of the auxiliary coil, holding the apparatus in place, should be soldered so that they will not work loose in shipment. The under side of the panel should be completely covered with a copper sheet, (42) at least 0.079 cm (1/32") thick, which forms part of the shield. Holes just large enough for the thermogalvanometer and variable air condenser shaft should be cut in this sheet as shown in print, Radio No.970-A. The word "High" should be engraved below the zero degree pointer setting of the two-plate variable air condenser and the word "Low" below the 180-degree setting of this condenser. The words "radio-frequency indicator, type B" with the frequency in kilocycles to which the instrument is to be adjusted may also be engraved on a convenient part of the panel.

Shield.-- A shield is provided so that nearby metallic objects will not change the calibration of the instrument after it is once set. This shield consists of a top shield on the under side of the panel as described under "Mounting," a cage shield constructed on a wooden framework which surrounds the instrument, and a bottom of sheet copper. The details of construction of this shield are shown in print, Radio No.970-C. The bottom of the wooden frame is covered with 0.079 cm (1/32") sheet copper (39). This is folded up 2.54 cms (1 inch) on all sides. A 2.54 cms (1 inch) x 0.079 cm (1/32") x 16.35 cms (6 7/16") copper strip (45) is soldered to the fold on the left end and extended vertically 1.11 cms (7/16") beyond the top of the wooden frame. This 7/16" extension is bent over the top of the wooden frame and fitted down in a 1/32" recess as shown in the side elevation of the shield in print, Radio No.970-C. A connecting frame (47) print, Radio No.970-C, cut from 0.079 cm (1/32") copper sheet should be fastened to the top of the main shield. This frame should be soldered to the connecting strip (45) where (45) passes under it. Its purpose is to make a good connection between the top shield (42) and the main shield when the frequency indicator is fastened in the case. Fifteen single wires are wound around the outside of the wooden frame and anchored as shown in print, Radio No.970-C. These wires do not

make a complete turn, the ends being anchored 0.953 cm (3/8") apart on the right end. Each wire is soldered to the vertical copper strip (45) on the right end. The completed shield is then substantially fastened in the box by means of 4 screws through the bottom shield as shown in print Radio No. 970-A.

Wiring.-- The wiring should be neatly done with No. 14 A.W.G. copper wire or larger. All connections should be soldered and as short as possible. The wiring should be in accordance with the circuit diagram on print Radio No. 970-D. It is important when connecting the right end of the main coil to the inner end of the auxiliary coil to see that the two coils are wound in the same direction.

Box.-- The whole device should be included in a suitable box. From print Radio No. 970-A it will be noted that two of the screw holes in the top panel are countersunk for a #8 wood screw so that the head is 0.317 cm (1/8") below the surface of the panel. This is for the purpose of sealing the instrument into the case after calibration.

If the frequency indicator is made exactly in accordance with the above specifications the following statement may be engraved on the top panel under the words "Radio frequency indicator, type B:" "Made according to U.S.Bureau of Standards specifications."

Bureau of Standards Test.-- The Bureau will calibrate or adjust only radio frequency indicators which are to be used to maintain a radio transmitting station on its assigned frequency. A fee of $5.00 is charged for adjusting a type B radio frequency indicator to a frequency within its range. For a frequency indicator which is defective or different from the type B design, the fee charged for the test, if made, will be an amount depending on the time required to make the test. When a frequency indicator is sent to the Bureau for test, the request for test should give the call letters and other data on the transmitting station in which it is to be used.

Table I

Number of turns to be put on main coil of Bureau of of Standards Type B frequency indicator.

1 Frequency	2 Turns on Main Coil	1 Frequency	2 Turns on Main Coil
510	52	698	31
516	51	712	30
522	50	728	29
529	49	744	28
536	48	760	27
543	47	777	26
550	46	796	25
558	45	814	24
566	44	837	23
573	43	862	22
581	42	890	21
590	41	920	20
598	40	954	19
608	39	990	18
618	38	1035	17
628	37	1080	16
639	36	1136	15
650	35	1196	14
662	34	1276	13
674	33	1390	12
686	32		

Department of Commerce,
Washington, D.C.

Attached drawings:
Radio Nos. 970-A, B, C and D. 1 blue prints LC-183

Note:- The blueprints may be obtained by persons who actually require them for construction of one of these frequency indicators, upon application to the Bureau of Standards.