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DESCRIPTION OF A SERIES OF SINGLE-LAYER INDUCTANCE COILS SUITABLE FOR RADIO-FREQUENCY STANDARDS*

Owing to the increased interest in radio-frequency measurements, this paper has been prepared giving rather detailed instructions for the construction of a series of single-layer inductance coils suitable for radio-frequency standards. Coils of this type have many uses in the laboratory where a fixed inductor of a known inductance and having a small radio-frequency resistance is desired. This type of coil in conjunction with a high-grade variable air condenser such as the Bureau of Standards type forms a very dependable and accurate wavemeter.

This series of inductors, seventeen in number, have been designed to cover the approximate inductance range of 8 to 5000 microhenries. Beginning with the smaller coil, each successive coil has approximately 1.5 times the inductance of the previous coil. The following table gives the approximate values of inductance of each of the coils in the several groups:

Coil designation number	Group	Inductance L microhenries
1	I	8.0
2	II	12.0
3	II	17.9
4	II	26.7
5	II	40.
6	III	59.8
7	III	89.4
8	III	134.
9	III	200.
10	IV	299.
11	IV	447.
12	IV	669.
13	IV	1000.
14	V	1495
15	V	2235
16	V	3342
17	V	5000

*Prepared by J.L.Preston, Physicist, and M.S.Strock, Assistant Physicist.

The several coils have been designed and grouped so that the coil rings for the coils in groups II, III and IV, are cut from the waste from the rings in group V. The coil in group I (one coil only) is small and is therefore grouped by itself to avoid design difficulties.

No definite specifications for size and kind of wire can be given. It is probable that after the complete series of coils have been made, either in sheet or molded materials, sufficient measurements can be made to determine these factors. It is possible to use various kinds of solid conductor such as bare copper, tinned or nickeled bare copper, enameled copper, single or double cotton covered copper, single or double silk covered copper. All other factors being the same, when solid copper wire is used, the bare wire would be preferable. This is because (1) such wire does not add another dielectric in the field of the coil and, (2) cotton, silk or other such fibers may contain a percentage of moisture which will further add to the distributed capacity of the coil. When bare wire is used it would seem preferable, from the standpoint of appearance and also because of certain electrical and mechanical advantages, to use either tinned or nickeled wire. The uncoated wire will become discolored and form an oxide coat which is not a good dielectric. Furthermore, the tinned or nickeled wire is more easily soldered. If silk or cotton covered wire is used, it is probable that the silk would be preferable, but for general use it can not be definitely stated that the advantage gained would be sufficient to demand its use. The use of solid enameled wire may add to the appearance of the finished coil and for the coils having sufficiently large winding pitch, the electrical characteristics may for practical purposes, be comparable to those of cotton or silk covered wire.

High-frequency ("litzendraht") cable can also be used. It is understood that high-frequency cable employs two types of dielectrics (insulation) in itself. The individual strands are of small diameter wire, enamel covered, and the assembled cable is given a single or double serving of silk. This outer covering is essential to protect the fine wire and the enamel insulation underneath. If high-frequency cable is used, it is very important that it pass certain requirements. Two important requirements are, that each individual strand should be continuous throughout the entire length of the cable and each strand should be insulated from every other strand throughout the entire length. As to the size of the wire it would seem that, for mechanical reasons, the wire should not be much larger than No.18 (B & S). This limitation permits of the use of high-frequency cable as large as 48 strands of No. 38 wire.

Department of Commerce,
Washington, D.C.

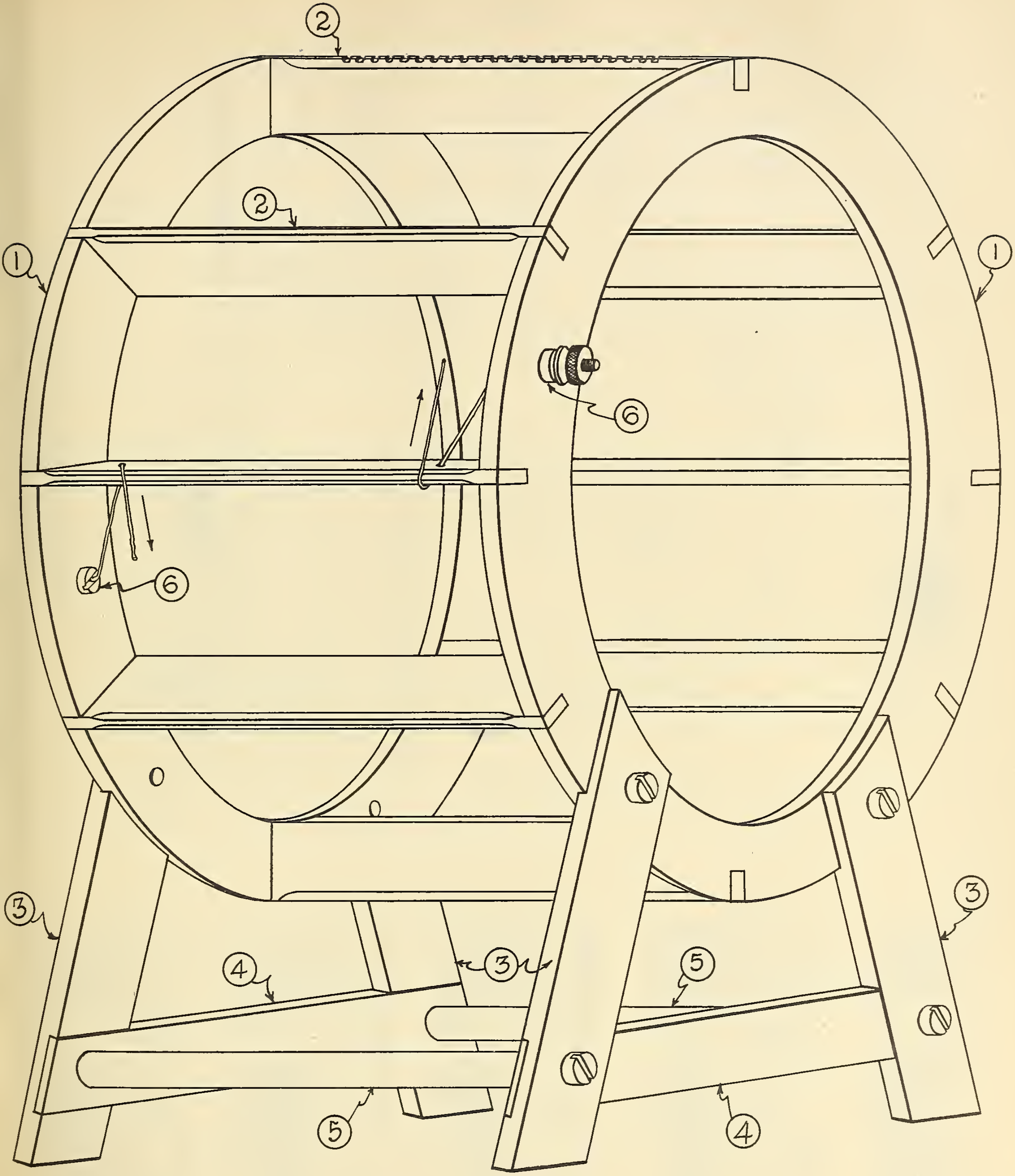

Fig. 1. – Assembled Inductance Coil Framework Showing Location of Binding Posts and Method of Winding. Symbols Refer to Fig. 2 .

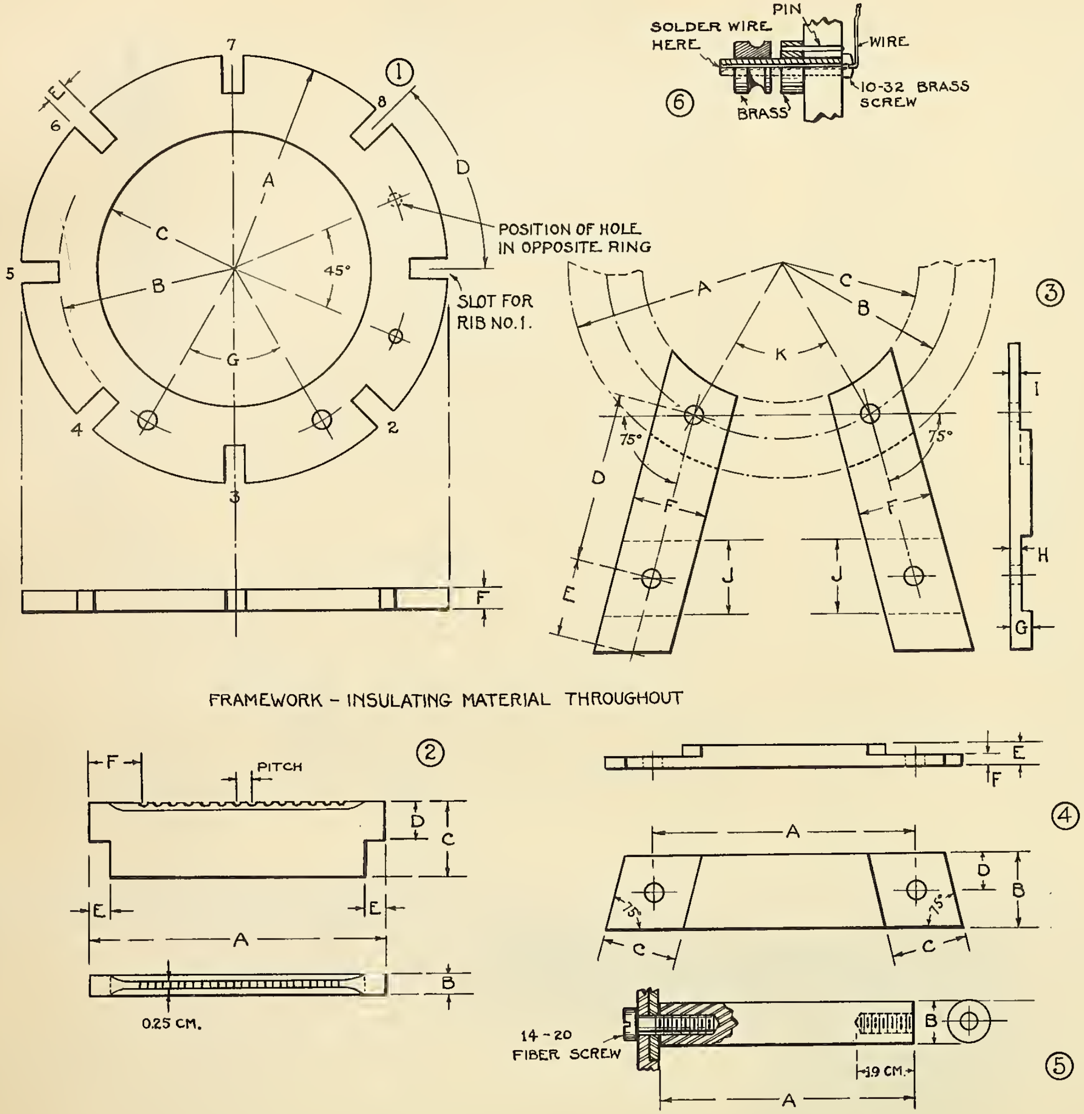

FIG. 2.– WORKING DIMENSIONS FOR PARTS OF INDUCTANCE COIL FRAMEWORKS.

FRAMEWORK FOR GROUP I.			DIMENSIONS IN CENTIMETERS.									
COIL NO. 1; PITCH 0.6cm; NUMBER OF TURNS 8.												
SYM.	REQ	DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K
1	2	RING	6.24	5.12	4.01	45°	0.64	0.95	58.5°				
2	8	RIB	8.71	0.64	2.22	1.11	0.95	1.95					
3	2	LEG-RIGHT	6.24	5.12	4.01	4.92	2.05	2.22	0.95	0.48	0.48	2.23	58.5°
3	2	LEG-LEFT	6.24	5.12	4.01	4.92	2.05	2.22	0.95	0.48	0.48	2.23	58.5°
4	2	END BRACE	7.56	2.22	2.22	1.11	0.95	0.48					
5	2	BRACE ROD	7.75	1.27									

FRAMEWORK FOR GROUP II.	DIMENSIONS IN CENTIMETERS	
COIL NO. 2; PITCH 0.6; TURNS 8	A-SYM. 2, 8.71	A-SYM. 5, 7.75
" " 3 " 0.6 " 10	" " 2, 9.91	" " 5, 8.95
" " 4 " 0.6 " 13	" " 2, 11.71	" " 5, 10.75
" " 5 " 0.4 " 14	" " 2, 9.51	" " 5, 8.55

SYM	REQ	DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K
1	2	RING	8.32	7.05	5.78	45°	0.64	0.95	61.5°				
2	8	RIB	*	0.64	2.54	1.27	0.95	1.95					
3	2	LEG-RIGHT	8.32	7.05	5.78	5.72	2.29	2.54	0.95	0.48	0.48	2.55	61.5°
3	2	LEG-LEFT	8.32	7.05	5.78	5.72	2.29	2.54	0.95	0.48	0.48	2.55	61.5°
4	2	END BRACE	10.19	2.54	2.54	1.27	0.95	0.48					
5	2	BRACE ROD	*	1.27									

*GIVEN ABOVE

FRAMEWORK FOR GROUP III.	DIMENSIONS IN CENTIMETERS	
COIL NO. 6; PITCH 0.6; TURNS 15	A-SYM. 2, 12.91	A-SYM 5, 11.95
" 7 " 0.6 " 19	" " 2, 15.31	" " 5, 14.35
" 8 " 0.4 " 22	" " 2, 12.71	" " 5, 11.75
" 9 " 0.4 " 28	" " 2, 15.11	" " 5, 14.15

SYM.	REQ	DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K
1	2	RING	12.0	10.41	8.83	30°	0.64	0.95	80.5°				
2	12	RIB	*	0.64	3.18	1.59	0.95	1.95					
3	2	LEG-RIGHT	12.0	10.41	8.83	8.38	2.77	3.18	0.95	0.48	0.48	3.18	80.5°
3	2	LEG-LEFT	12.0	10.41	8.83	8.38	2.77	3.18	0.95	0.48	0.48	3.18	80.5°
4	2	END BRACE	17.83	3.18	3.18	1.59	0.95	0.48					
5	2	BRACE ROD	*	1.27									

*GIVEN ABOVE

FRAMEWORK FOR GROUP IV.	DIMENSIONS IN CENTIMETERS	
COIL NO. 10; PITCH 0.4; TURNS 28	A-SYM. 2, 15.11	A-SYM. 5, 14.15
" 11 " 0.4 " 37	" " 2, 18.71	" " 5, 17.75
" 12 " 0.4 " 48	" " 2, 23.11	" " 5, 22.15
" 13 " 0.2 " 50	" " 2, 12.91	" " 5, 11.95

SYM.	REQ.	DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K
1	2	RING	15.86	14.27	12.68	30°	0.64	0.95	76°				
2	12	RIB	*	0.64	3.18	1.59	0.95	1.95 / 1.45 = COIL 13					
3	2	LEG-RIGHT	15.86	14.27	12.68	9.53	3.28	3.18	0.95	0.48	0.48	3.18	76°
3	2	LEG-LEFT	15.86	14.27	12.68	9.53	3.28	3.18	0.95	0.48	0.48	3.18	76°
4	2	END BRACE	22.43	3.18	3.18	1.59	0.95	0.48					
5	2	BRACE ROD	*	1.59 / 1.27 = COIL 10 & 13									

*GIVEN ABOVE

FRAMEWORK FOR GROUP V.	DIMENSIONS IN CENTIMETERS	
COIL NO. 14; PITCH 0.4; TURNS 65	A-SYM. 2. 28.91	A-SYM. 5. 27.95
" " 15 " 0.2 " 66	" " 2, 16.11	" " 5, 15.15
" " 16 " 0.2 " 86	" " 2, 20.11	" " 5, 19.15
" " 17 " 0.2 " 114	" " 2, 25.71	" " 5, 24.75

SYM.	REQ	DESCRIPTION	A	B	C	D	E	F	G	H	I	J	K
1	2	RING	20.24	18.33	16.43	22.5°	0.64	0.95	76.5°				
2	16	RIB	*	0.64	3.81	1.91	0.95	1.45					
3	2	LEG-RIGHT	20.24	18.33	16.43	11.94	3.96	3.81	0.95	0.48	0.48	3.82	76.5°
3	2	LEG-LEFT	20.24	18.33	16.43	11.94	3.96	3.81	0.95	0.48	0.48	3.82	76.5°
4	2	END BRACE	28.8	3.81	3.81	1.91	0.95	0.48					
5	2	BRACE ROD	*	1.59 / 1.27 = COIL 15									

*GIVEN ABOVE