CANADIAN STANDARDS ASSOCIATION
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CANADIAN ELECTRICAL CODE
PART IV

RADIO

C22.4 No. 107—1949

TOLERABLE LIMITS AND SPECIAL METHODS OF MEASUREMENT OF RADIO INTERFERENCE

FROM

WIRE COMMUNICATION AND SIGNAL SYSTEMS

CSA STANDARD
1949

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CONTENTS

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PREFACE

The problem of setting tolerable limits to radio interference from wire communication and signal systems is being dealt with by Sub-Panel 10, Panel 5, Canadian Electrical Code—Part IV (Radio) as a matter of co-ordination of certain features of the two public services, i.e., wire communication and radio.

Consideration is given to the practicability of the limits specified from the standpoint of technical practice and, also, of economic feasibility.

The problem of co-ordinating radio reception and radio interference from communication and signal systems calls for good engineering practice in connection with both the radio system and the communication or signal system.

The tolerable limits of radio interference specified herein are intended to ensure freedom from interference to radio reception when the apparatus in question is in normal operation. In arriving at these tolerable limits various factors of signal intensity and coupling from source of interference to the receiver have been taken into consideration.

The tolerable limits have been set to make a compromise between the ideal technical solution and economic feasibility and are intended to provide a degree of protection to radio reception corresponding to that provided by other sections of Part IV of the Canadian Electrical Code and required by Federal legislation.

This specification will be revised from time to time as the art develops. Comments or data bearing on this subject will be welcomed and correspondence on this matter should be sent in duplicate to:

The General Manager, Canadian Standards Association,
National Research Building,
Sussex Street, Ottawa, Ontario.

and will be recorded and brought to the attention of the Committee in charge of drafting this Code.

It is recognized that these recommendations represent the voluntary contribution of the equipment manufacturers, signal and communication system operators, radio broadcasting and allied industries, towards the solution of a problem which has arisen through the development of radio services.

This Code was formally approved, by letter ballot, by Sub-panel 10, Panel 5, C.E. Code Part IV in August, 1945; by Panel 5, C.E. Code Part IV in April, 1946; by the Committee on C.E. Code Part IV in March, 1949; and by the CSA Main Committee, with authority to publish it as a CSA Standard in April, 1949.

OTTAWA, August, 1949.

NOTE:—*Publication of this Code was held up pending recent developments towards international unification of procedures and practices relative to the subject and it is now considered practical for the CSA to publish the Code for the purpose of obtaining field experience in the application of its details.*

CANADIAN ELECTRICAL CODE
PART IV

RADIO

C22.4 No. 107—1949

TOLERABLE LIMITS AND SPECIAL METHODS OF MEASUREMENT OF RADIO INTERFERENCE
FROM
WIRE COMMUNICATION AND SIGNAL SYSTEMS

SECTION 1

SCOPE

Rule 101

GENERAL

General

(a) This Code applies to radio interference (both transient and sinusoidal) originating on any part of communication or signal systems.

(b) Systems liable to cause interference and which are covered by this Code include railway and other signal and communication systems and apparatus of the following types:

(1) Telephone Dials
(2) Telegraph keys and relays, etc.
(3) Telephone ringing and tone producing generators
(4) Teletype and other communication transmitting apparatus
(5) Communication receivers other than radio—oral, visual and recording
(6) Telephone relays and other similar apparatus
(7) Traffic control apparatus and systems
(8) Railway crossing signals—wig-wag, bells, flashing lights, etc.
(9) Carrier Current Systems not licensed under the Radio Act, 1938, except those operating below 500 kc/s using less than one watt, which will be included in the Scope of this Code if operating experience indicates the necessity therefore.

(c) The tolerable limits specified are based on the operation of the system as a whole.

(d) Appendix "A" describes a variety of interference suppression schemes used with the systems referred to in Rule 101(b).

Rule 102

PROTECTED FREQUENCIES

Protected Frequencies

(a) The tolerable limits herein specified apply to all frequencies above 10,000 cycles per second allotted for radio communication.

Rule 103

MEASUREMENT

Measurement

(a) Complete instructions for measuring **interference field intensity** are given in C22.4 No. 101—"Interference Measuring Instruments and Methods of Measurement". For method of measuring **interference field intensity** from power lines see Section 3 herein.

Rule 104

DEFINITIONS

Definitions

(a) The following definitions refer to the terms printed in bold-face type in the body of the Code.

The **interference field intensity** is the electric field intensity produced by the interference as measured on a **standard interference measuring instrument,** having an antenna of known effective height located at a point prescribed in the specification of the Canadian Electrical Code Part IV for the particular type of apparatus, line or system concerned.

Unit — Microvolts per metre.

For the purpose of this Code, **Residence** is defined as a building equipped for radio reception and located within 200 ft of the line under investigation.

STANDARD INTERFERENCE MEASURING INSTRUMENT is an instrument for measuring equivalent microvolts of interference and **interference field intensity** at radio frequency, which is approved as standard by the Canadian Electrical Code (See C22.4 No. 101—"Interference Measuring Instruments and Methods of Measurement" for complete description).

SECTION 2

GENERAL REQUIREMENTS

Rule 201

GENERAL

General

(a) For general information regarding requirements of the Canadian Electrical Code Part IV, see C22.4 No. 100—"General Requirements, Definitions and Procedure Relative to the Control of Radio Interference".

Rule 202

MEASUREMENT

Measurement

(a) For details of measuring equipment and technique, see C22.4 No. 101—"Interference Measuring Instruments and Methods of Measurement".

SECTION 3

METHOD OF MEASUREMENT

Rule 301

METHOD OF MEASURING INTERFERENCE FIELD INTENSITY FROM POWER LINES

Method of Measuring Interference Field Intensity from Power Lines

(a) An approved interference measuring instrument calibrated to read in microvolts per metre and having, if practicable, a vertical antenna of less than 4 ft in height, shall be located at or near the ground immediately below the line wires to be tested at a point where, if practicable, the line wires are 35 ft from the ground. This location shall be as free as possible from other conductors which may increase or decrease the **interference field intensity** at the point of testing.

(b) In cases where the line is not 35 ft above the ground, or the test antenna is more than 4 ft in height, a correction factor shall be applied according to the following Table:—

CORRECTION FOR HEIGHT OF LINE

Height of line feet	Add to db reading		Multiply microvolts per metre by:	
	4-ft Antenna	7-ft Antenna	4-ft Antenna	7-ft Antenna
50	+4	+3	1.6	1.4
45	+3	+2	1.4	1.25
40	+2	+1	1.25	1.1
35	0	−1	1.0	0.9
30	−2	−3	0.8	0.7
25	−4	−5	0.63	0.55
20	−6	−7	0.5	0.45

NOTE:—*This Table is based on experimental data obtained by the Department of Transport.*

SECTION 4

TOLERABLE LIMITS

Rule 401

GENERAL

General

(a) Radio interference from wire communication and signal systems shall not exceed the tolerable limits specified in either of the following Rules.

Rule 402

Interference from Line Wires

INTERFERENCE FROM LINE WIRES

(a) The **interference field intensity,** caused by the interference (from the communication or signal apparatus concerned) being radiated from line wires or carrier current systems not licensed for communication, associated with the source of interference, when measured as specified in Section 3 shall not exceed the following:—

(1) When there are more than 50 **residences** in any one mile of line, the **interference field intensity** measured within that mile shall not exceed 50 microvolts per metre (34 db above one microvolt per metre).

(2) When there are more than 10, but not exceeding 50 **residences** in any one mile of line, the **interference field intensity** measured within that mile shall not exceed 100 microvolts per metre (40 db above one microvolt per metre).

(3) When there are not more than 10 **residences** in any one mile of line, the **interference field intensity** measured within that mile shall not exceed 150 microvolts per metre (43.5 db above one microvolt per metre).

NOTE:—*Interference originating on the line wires or associated apparatus is dealt with in C22.4 No. 103—"Tolerable Limits and Special Methods of Measurement of Radio Interference from High Voltage Lines and Apparatus".*

Rule 403

Interference by Direct Radiation from Apparatus

INTERFERENCE BY DIRECT RADIATION FROM APPARATUS

(a) Apparatus operated by the Owner and installed on his property:—

The **interference field intensity** caused by direct radiation from units or groups of apparatus which are operated by the Owner and which are installed on property controlled by the Owner shall not exceed 16 microvolts per metre (24 db above one microvolt per metre) at any point on or beyond the boundary of that property.

(b) Apparatus operated by the Owner but installed on property not owned or controlled by the Owner:—

The **interference field intensity** caused by direct radiation from units or groups of apparatus which are operated by the Owner but which are installed on property not owned or controlled by the Owner of the apparatus shall not exceed 10 microvolts per metre (20 db above one microvolt per metre) at any point not less than 30 ft from the wall or housing within which the apparatus is installed.

(c) Apparatus installed on a User's premises as part of a communication or signal service.

The **interference field intensity** caused by direct radiation from units or groups of apparatus which are installed on the User's premises as part of a communication or signal service shall not exceed 10 microvolts per metre (20 db above one microvolt per metre) at any point not less than 30 ft from the case or housing within which that apparatus is installed.

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APPENDIX A
RADIO INTERFERENCE SUPPRESSORS
FOR
WIRE COMMUNICATION AND SIGNAL SYSTEMS

CONTENTS

1. SCOPE

This Appendix describes standard types of radio interferences suppression devices commonly used in telegraph and telephone systems, railway signal systems, street traffic control systems, and other signal systems.

2. MEANS OF SUPPRESSION

Radio interference suppression devices are of the following general types:

(a) Shielding to prevent direct radiation.
(b) Capacitors to provide a low impedance by-pass.
(c) Inductors to present a high impedance circuit to interfering surges.
(d) Resistors to dissipate radio frequency energy.
(e) Application of spark eliminators at the source.

3. CONNECTION TO RADIO INTERFERENCE DEVICES

Suppression devices should be located as close as possible to the source of interference and connected with the shortest practicable leads.

4. SHIELDING

Shielding of inside wiring is sometimes effective in reducing radio interference. Shielding may be applied either to the antenna system or to the wires which are radiating the interference. In the case of the antenna system, shielding is usually accomplished by the use of a shielded lead-in. In the case of the disturbing circuits shielding may be provided by running them in lead covered cable or metal conduit. All sections of the shielding medium should be thoroughly bonded together.

5. RADIO INTERFERENCE SUPPRESSION COMPONENTS

(a) **Capacitors.** Capacitor values are shown in Sections 7. These capacitors should be non-inductive. The voltage rating should be ample for the particular application.
(b) **Inductors.** The values of the inductors are shown in Section 7. In order that the distributed capacity of the inductors may be kept at a minimum, the winding may be single layer type, or some form of low capacity multilayer winding such as bank, honey-comb or duolateral, &c.
(c) **Resistors.** The values of the resistors are shown in Section 7. The wattage rating should be ample for the particular application.

6. WIRING

Leads or connections between the source of interference and the suppressor units should be kept as short as possible. They should be mechanically strong and installed and maintained to a high standard.

7. SOURCES OF INTERFERENCE AND REMEDIAL MEASURES

7.1 **Telephone Dials**
Remedial Measures

(a) On certain types of telephone sets to which the method is applicable short circuit the induction coil during dialing by use of a special connection of the off-normal contacts.
Approximate suppression—5 to 35 db.
(b) Where above method is not applicable or does not provide adequate suppression, connect a filter across the pulsing contacts of the dial (Fig. 107–1). Approximate suppression 40 to 55 db.

7.2 **Telephone P.B.X. Systems**

7.21 **Dial Type P.B.X.**
Remedial Measures

(a) Connect a choke coil in each line leaving the P.B.X. (Fig. 107–2).
(b) Connect two choke coils in parallel-aiding in battery charging leads and P.B.X. ground leads (Fig. 107–3).
(c) Connect a 1 mf condenser across the battery and ground supply busbars in the cabinet. Protect with a 1⅓ ampere fuse. (Fig. 107–4). **Approximate suppression** 35 to 40 db.

7.22 **Manual P.B.X. Systems**
Remedial Measures

(a) Connect a choke coil in each line leaving the P.B.X. and a 0.2 mf condenser from the line side of each of these choke coils to the central office ground, if present. Otherwise to the local ground (Fig. 107–2).
(b) Connect two or more choke coils in parallel-aiding in each of the battery supply leads to the Central Office (Fig. 107–3).
(c) Connect a condenser and resistance in series across the contacts of each auxiliary alarm relay (Fig. 107–5).
(d) Ground the framework and the hand generator frame to the battery supply ground on the line side of the choke coil. **Approximate Suppression** 35 to 50 db.

7.23 **Manual P.B.X. Systems — Cordless Type**
Remedial Measures

(a) Same as 7.22 (a).
(b) Same as 7.22 (b).
(c) Connect a condenser and resistance in series across the contacts of the (S) and (T) relays (Fig. 107–6).
(d) Ground the relay and key mounting frames to the central office ground. Remove the existing ground connection to the trunk signal mounting frame and strap this frame to the key mounting frame.

Approximate Suppression 30 to 45 db.

7.3 **Telephone Central Office Equipment**

7.31 **General Remedial Measures**

Various items of central office equipment may cause radio interference with different degrees of severity. In some cases the remedy is to apply suppression to the particular piece of equipment causing the trouble while in other cases it may be necessary to place filters in all lines leaving the office. In general the latter remedy will not be required where telephone circuits leave the central office in underground cables having lengths of several hundred feet or more. The application of these measures follows:

(a) **Telephone Lines**
Apply filters at the main frame to all telephone pairs leaving the office (Fig. 107–7).
Approximate Suppression 30 to 60 db.

(b) **Power Lines**
Connect a commercial capacitive type filter in the power supply lines at the point of entrance into the central office.

(c) **Additional Measures**
The following additional measures may be adopted where the central office equipment is in steel cabinets:
(i) Bond the office ground lead, the positive main battery lead and the positive charging lead to the metal cabinet.
(ii) Connect the negative main battery lead and the negative charging lead through 0.7 mf condensers to the cabinet.
(iii) Separate ground and power leads leaving the cabinet from all other leads leaving the cabinet.
(iv) Shield any tie cables between cabinets.
Where the equipment is not contained in cabinets, connect a condenser across the battery supply busbars (Fig. 107–4).

7.32 **Measures Applied to Specific Items of Equipment**
The following measures are applicable to specific items of telephone central office equipment. Owing to the wide variety of such equipment in use, only a few typical examples can be covered here:

(a) **Battery Operated Interrupters**
Connect filters in all leads except the operating battery leads which should not exceed one foot in length (Fig. 107–8).
Approximate Suppression 40 to 60 db.

(b) **Motor Driven Interrupters and Ringing Machines**
Connect filters in all tone and battery leads (Fig. 107–8).
Approximate Suppression 25 db.

(c) **Vibrator Type Interrupters**
Connect a filter across the vibrator contact and the armature. Also connect drainage condensers between the frame and the vibrator contact and between terminals 1 and 9 and the frame (Fig. 107–9).
Approximate Suppression 40 db.

(d) **Mercury Arc Rectifiers**
(i) Connect two condensers in series, with the midpoint grounded, across the a-c supply line.
(ii) Connect 1 mf condensers between each a-c supply line and the cathodes of the tube.

(e) **Tungar Rectifiers**
(i) Treat as in 7.32 (d) (i) above.
(ii) If this measure gives inadequate suppression connect a commercial type retardation coil in each a-c line in addition to the condensers.

(f) **Telephone Relays**
Treat as in (Fig. 107–5).

7.4 **Code Calling Systems**
Connect a filter across the relay contacts (Fig. 107–11).
Approximate Suppression 28 to 47 db.

7.5 **Teletype Systems**
Suppression Devices for use on Teletype Systems

Equipment	Induction Source	Teletype Corpn. Filter (or other Make as specified)	REMARKS
No. 14 Teletypewriter	Sending contacts	93885M	
	Line relay contacts	97301M	
	Motor governor and commutator	none	Req'd, only with governed motors
	Power leads	122A	
No. 14A Perforator	Perforator magnet contacts	None	
No. 14 or 20 Transmitter-Distributor	Distributor sending segments and brushes	92226M	
	Motor governor	95326M	
No. 14 or 20 Reperforator	Line relay contacts	92229M	
No. 15 or 20 Teletypewriter	Sending contacts	93884M	
	Line relay contacts	92227M	
	Motor governor and commutator	None	Required only with governed motors.
	Power leads	122A	
No. 15 Perforator Transmitter (used on 19)	Sending contacts	93884M	Required only for 15A, 15B or 15C
	Cam. pulsing contacts	92224M	
	Universal bar contacts	92225M	
	Counter control contacts	92243M	
128C1 Teletypewriter subscriber set	Sending relay contacts and receiving relay contacts	W.E. 88D	One 88D filter unit required for each polar relay.
128B2 Teletypewriter subscriber set	Sending relay contacts	88D	
	Receiving relay contacts	88D	
	Certain terminals of set required by-passing to ground	.01 mf	Use 313D condenser —3 units of .01 mf each.
Miscellaneous contacts (Neutral or Polar Relays Manual Telegraph Keys or Mechanically Operated Contacts)		88A, 88C or 88D	Use 88D or 88C on polar relays. Use 88A on keys and infrequently operated relay contacts.

7.6 **Telegraph Keys and Relays**

Remedial Measures
(a) See listing above, under "Miscellaneous Contacts", for treatment of telegraph keys and relays. See also Fig. 107–5.
(b) Condenser across battery busbars (Fig. 107–4).

(c) 0.05 mf condenser across battery and supply retardation coils. **Approximate Suppression** 40 to 50 db.

7.7 **Communication Receivers: Oral, Visual and Recording**
Remedial Measures
Treat relays and contacts as in Fig. 107–5.

7.8 **Traffic Control Apparatus and Systems**
Standard units are incorporated in traffic control apparatus and consist of standard condenser - retardation coil combination.

7.9 **Railway Crossing Signals, Wig Wags, Bells, Flashing Lights, etc.**
Latest apparatus is provided with suppression devices consisting of condensers, resistors, or condenser - retardation coil combinations. If apparatus not so equipped connect a 1 mf. condenser across contacts causing trouble.

7.10 **Carrier Current Systems not Licensed under the Radio Act —1938**
Remedial Measures
Treat relays and contacts as in Fig. 107–5.

7.11 **All Other Signal Systems**
Signal systems, including alarm systems, other than those described above and making use of comparable relays, rectifiers and other contact making elements, may be equipped with appropriate suppression devices as described under Section 7.3 to Section 7.5 inclusive, as required.

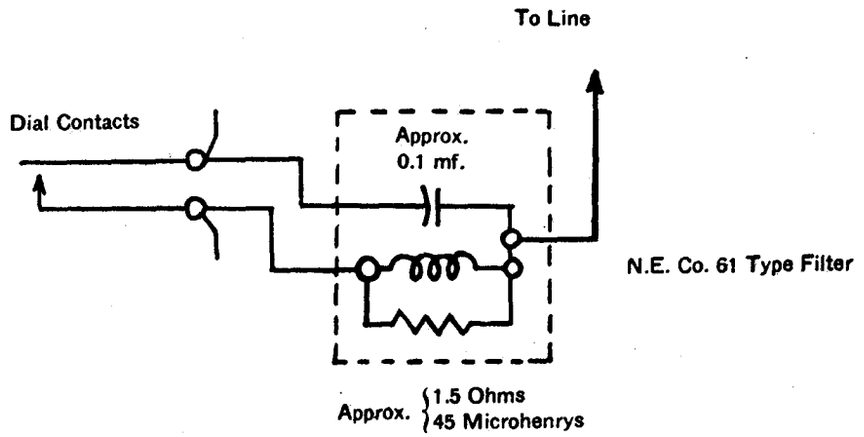
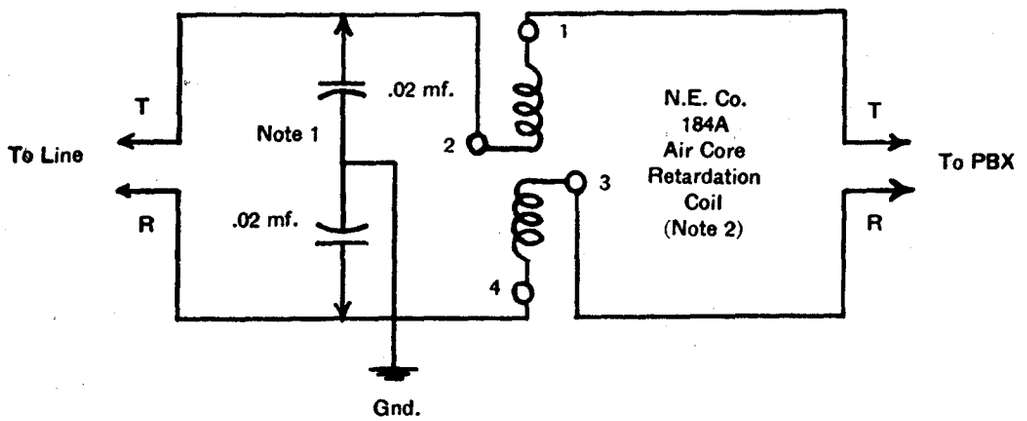


FIG. 107–1



Note 1:—Provide Condensers when required
See 7.22 (a) and 7.23 (a)

Note 2:—Constants of 184A retardation coil (per winding)
Inductance — 1 millihenry
Resistance — 1 ohm
Resonant Frequency — 1200 Kc

FIG. 107–2 — Typical Connection of Choke Coil in a Talking Pair

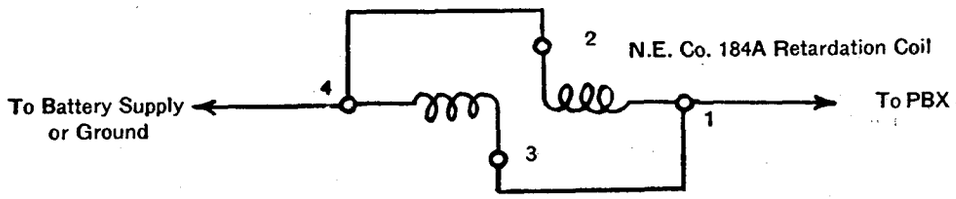


FIG. 107–3 — Typical Connection of Choke Coil in a Battery Supply or Ground wire.

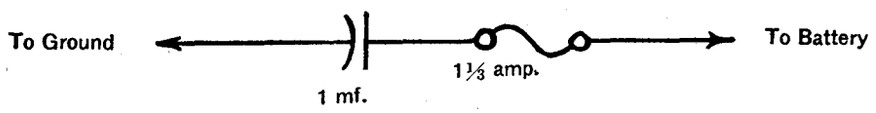


FIG. 107–4

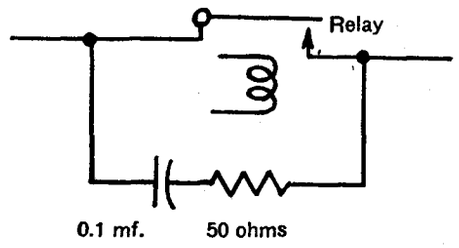


FIG. 107–5

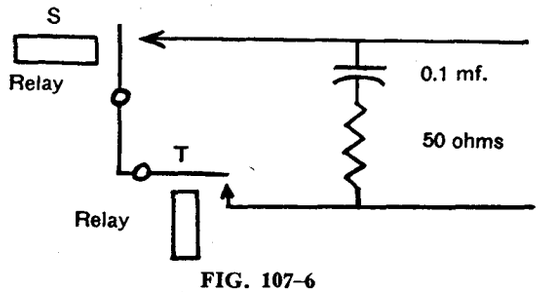


FIG. 107–6

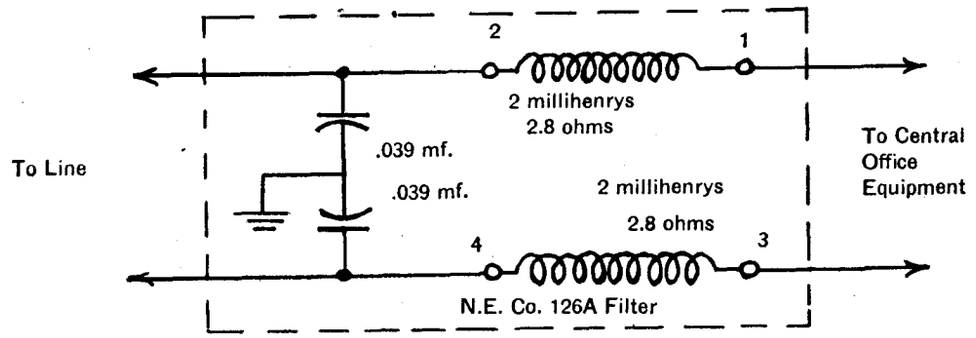


FIG. 107–7

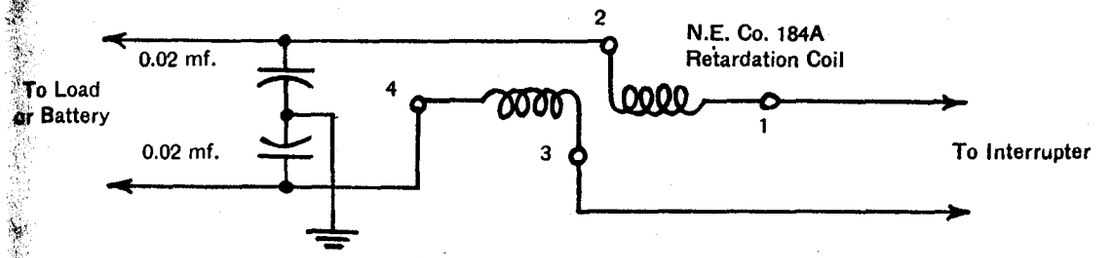


FIG. 107–8

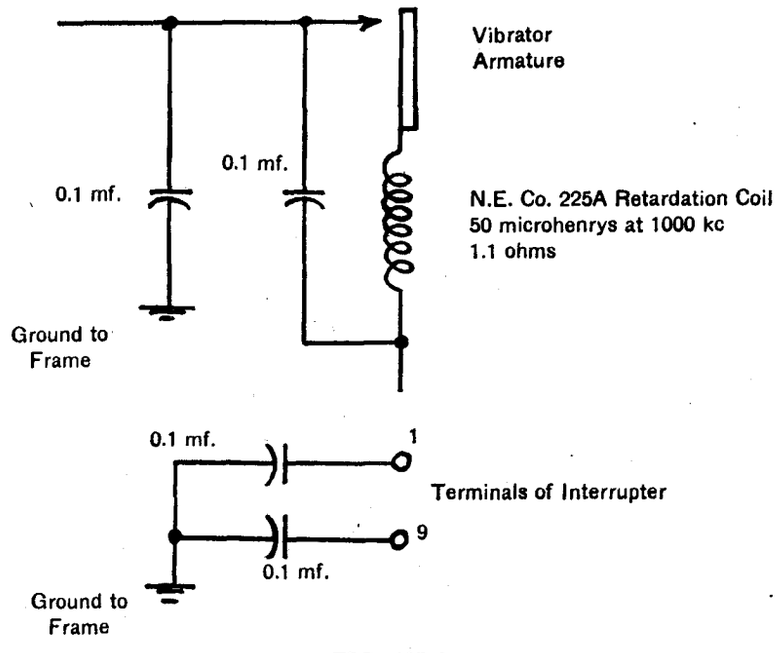


FIG. 107–9

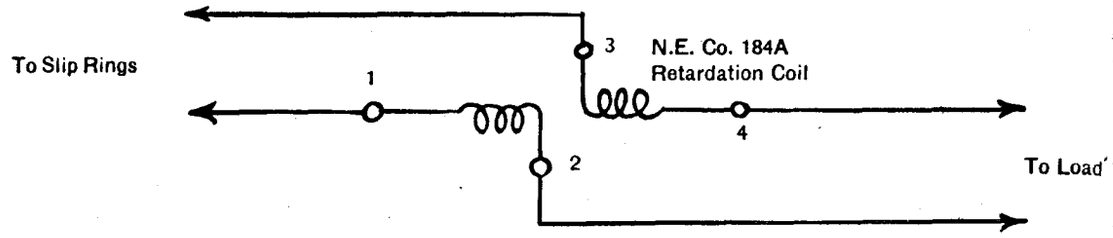


FIG. 107–10

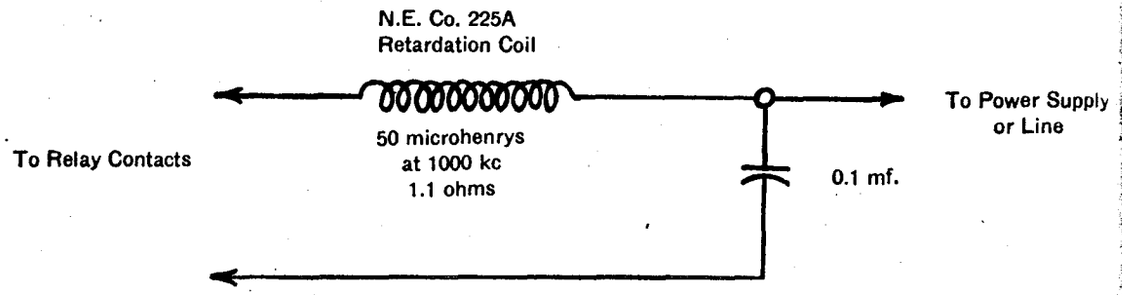


FIG. 107–11