

This type may also be used for switchboard or office installations, instead of repeating coils, and in this case it is generally the practice to install a condenser in series with each side of the line, between the coil and the jack, as in a simplex set (Par. 116).

84. **Identical side circuits** should always be employed in deriving metallic phantom circuits, for the best results. This is necessary for the proper electrical balance of the phantom. Special transpositions are also required; see Par. 168 and 169.

85. **Grounded phantoms**, or half phantoms, can be obtained by connecting repeating or impedance coils to a metallic circuit and employing an earth return for one side of the phantom. This arrangement is open to the same objections which apply to the use of ground-return circuits in

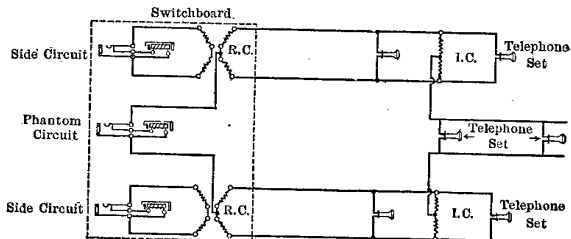


FIG. 33.—Phantom circuit.

general—namely, cross-talk and noise caused by lack of transposition and by earth potentials.

86. **Phantom circuits in cable** require specially constructed cables of the quadred type, described in Par. 150. This form of construction is essential in order to transpose the phantom and prevent cross-talk.

87. **The repeating and impedance coils** for phantom circuits should be carefully balanced electrically in order to prevent cross-talk between the side circuits and the phantom. The windings should be subdivided, grouped and balanced in such a way that the currents of the phantom circuit will induce (electromagnetically) no e.m.f.s. in the side circuits and vice versa; see also Par. 57. The toroidal type of coil with two inner and two outer windings, 35 ohms per winding, is extensively used.

STANDARD MANUAL TELEGRAPH SYSTEMS

88. **The manual Morse telegraph system** comprises a means of transmitting combinations of short and long impulses or signals over an electrical circuit joining two or more points; the transmitting mechanism consists of a hand-operated key and the receiver consists essentially of an electromagnet with a sound-amplifying device for audibly registering the signals, which are read by ear. The combinations of long and short signals are so arranged as to form a code or alphabet, of which there are two in common use; the **Morse alphabet** is universally employed in American practice (except wireless) and the **Continental alphabet** in Europe.

89. **Morse characters.** The basic element of the Morse alphabet is the dot; a dash is equal in duration to three dots; the space between the elements of a letter equals one dot; between complete letters of a word, three dots; between words, six dots. The 26-letter American Morse alphabet has 77 elements, or an average of 2.96 elements per letter; the Continental alphabet of 26 letters has 82 elements, or 3.15 elements per letter. The average five-letter word has 36.7 elements or dot-equivalents in American Morse. A speed of 25 words per min. in American Morse corresponds to an average of 370 signals per min., or between 6 and 7 per set.

90. Morse and Continental Alphabets. *

TELEGRAPH CHARACTERS			
Morse		Continental	
A	.-
B	..-.
C	.-.-
D	.-.-.
E	.-
F	.-.-.-
G	.-.-.-.
H	.-.-.-.-
I	..-.-
J	.-.-.-.-.
K	.-.-.-.-.
L	.-.-.-.-.
M	.-.-.-.-.
N	.-.-.-.-.
O	.-.-.-.-.
P	.-.-.-.-.
Q	.-.-.-.-.
R	.-.-.-.-.
S	.-.-.-.-.
T	.-
U	..-
V	..--
W	.-.-
X	.-.-.-
Y	.-.-.-.
Z	.-.-.-.-
&	.-.-.-.-.
1	.-.-.-.-.
2	.-.-.-.-.
3	.-.-.-.-.
4	.-.-.-.-.
5	.-.-.-.-.
6	.-.-.-.-.
7	.-.-.-.-.
8	.-.-.-.-.
9	.-.-.-.-.
0	.-.-.-.-.

Short Numerals Generally Used By Continental Operators			
1	.-	3	.-.-
2	..	4	.-.-.-
3	.-	5	.-.-.-.-
4	..	6	.-.-.-.-.
5	.-	7	.-.-.-.-.
6	..	8	.-.-.-.-.
7	.-	9	.-.-.-.-.
8	..	0	.-.-.-.-.

Special Characters			
•	Paroid	.-	..
..	Colon	.-.-	..
.-	Colon Dash	.-.-	..
.-.-	Semi-Colon	.-.-	..
.-.-.-	Comma	.-.-.-	..
.-.-.-.-	Interrogation	.-.-.-.-	..
.-.-.-.-.-	Exclamation	.-.-.-.-.-	..
.-.-.-.-.-.	Fraction Line	.-.-.-.-.-.	..
.-.-.-.-.-.-	Dash	.-.-.-.-.-.-	..
.-.-.-.-.-.-.	Hyphen	.-.-.-.-.-.-.	..
.-.-.-.-.-.-.-	Apex	.-.-.-.-.-.-.-	..
.-.-.-.-.-.-.-.	Apogrophe	.-.-.-.-.-.-.-.	..
.-.-.-.-.-.-.-.-	Pound Sterling	.-.-.-.-.-.-.-.-	..
.-.-.-.-.-.-.-.-.	Shilling	.-.-.-.-.-.-.-.-.	..
.-.-.-.-.-.-.-.-.-	Pence	.-.-.-.-.-.-.-.-.-	..
.-.-.-.-.-.-.-.-.-.	Dollars	.-.-.-.-.-.-.-.-.-.	..
.-.-.-.-.-.-.-.-.-.-	Cents	.-.-.-.-.-.-.-.-.-.-	..
.-.-.-.-.-.-.-.-.-.-.	Colon Followed by Quotation	.-.-.-.-.-.-.-.-.-.-.	..
.-.-.-.-.-.-.-.-.-.-.-	Decimal Point	.-.-.-.-.-.-.-.-.-.-.-	..
.-.-.-.-.-.-.-.-.-.-.-.	Paragraph	.-.-.-.-.-.-.-.-.-.-.-.	..
.-.-.-.-.-.-.-.-.-.-.-.-	Parenthesis	.-.-.-.-.-.-.-.-.-.-.-.-	..
.-.-.-.-.-.-.-.-.-.-.-.-.	Brackets	.-.-.-.-.-.-.-.-.-.-.-.-.	..
.-.-.-.-.-.-.-.-.-.-.-.-.-	Quotation	.-.-.-.-.-.-.-.-.-.-.-.-.-	..
.-.-.-.-.-.-.-.-.-.-.-.-.-.	Quotation within a Quotation	.-.-.-.-.-.-.-.-.-.-.-.-.-.	..
.-.-.-.-.-.-.-.-.-.-.-.-.-.-	End of Quotation	.-.-.-.-.-.-.-.-.-.-.-.-.-.-	..
.-.-.-.-.-.-.-.-.-.-.-.-.-.-.	End of Quotation within Quotation	.-.-.-.-.-.-.-.-.-.-.-.-.-.-.	..
.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-	Percent	.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-	..
.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.	Capitalized Letter	.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.	..
.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-	Italic or Underline	.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-	..

91. **The closed-circuit Morse system** (Fig. 34) is almost universally employed in this country, except for installations of automatic printing systems, some of which employ multiplex or high-speed transmission. The ordinary closed-circuit Morse system, worked simplex, duplex, or quadruplex, is the only one here treated in any detail.

92. **The open-circuit Morse system** is employed extensively in England and on the Continent, but has never found favor in American

* Appendix "C" from McNicol's, "American Telegraph Practice," page 492.