"No-Such-Number" Tone for Dial Systems

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Switching Development

OCCASIONALLY a customer's error in dialing results in his reaching a group of numbers not assigned for service. In such cases a tone may be used to inform the customer of his error, and the "no-such-number" tone has been developed for this purpose. A distinctive tone was desired, which could be easily remembered and associated with the idea of disconnecting and then dialing the number again. Various combinations of existing tones were tried but none was distinctive enough to prevent confusion with those used to convey other information. An entirely new tone was developed which varies continuously in frequency, like that of a siren, alternately rising and falling at half-second intervals. Its sound is quite different from any other tone used in the Bell System.

A wave-form of the tone is shown in Figure 1; the fundamental frequency at the lowest pitch is 200 cycles per second, and at the highest pitch 400 cycles. Harmonics up to 6000 cycles are in both tones as shown in Figure 2; these give the tones a richness not found in single-frequency waves.

The circuit used to supply this tone is shown in Figure 3. A relaxation oscillator which consists of a vacuum tube T1, the condenser C1 and resistance R1 generates a tone whose frequency is a function of the potential on the grid of the tube. This grid potential is made to vary through a range of approximately one-half volt by the rate of charge and discharge of the condenser C2 through the resistance R4. With the relay INT alternately operated and released every half second the fundamental frequency varies between approximately 200 cycles and 400 cycles per second. Potentiometers P1 and P2 are maintained at one-half volt difference in potential by resistances R2 and R3 in the filament circuit. Since these two potentiometers are similar and have a shaft that is common to both, their rotor terminals always differ in potential by one-half volt.

Potentiometers, rather than fixed potentials, are employed to permit compensation for variations in the vacuum tube characteristics. The tone circuit operates from the 48-volt central-office battery and variations in voltage are compensated by a bal-

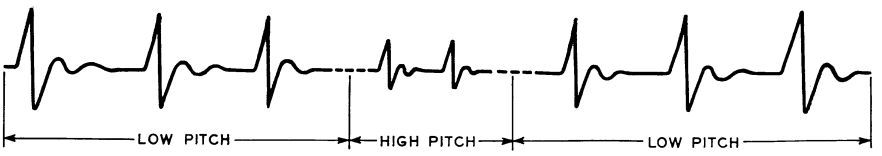

Fig. 1—The "no-such-number" tone is a train of oscillations whose fundamental frequency varies between 200 and 400 vibrations per second

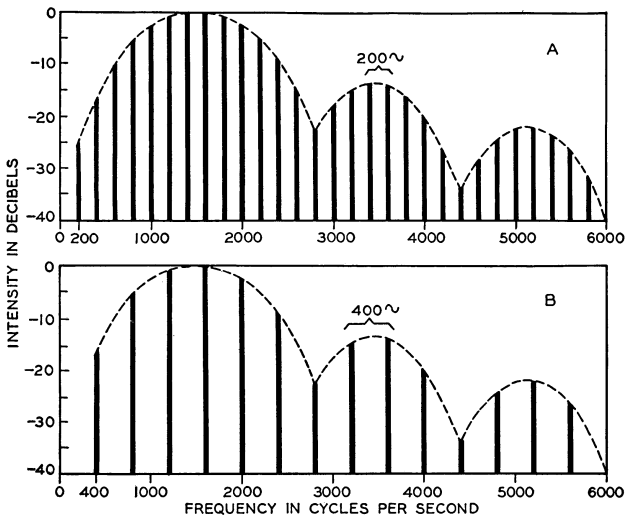

Fig. 2—Each oscillation of the tone consists of a fundamental and many harmonics. The envelope of the intensities of the harmonics is substantially the same for any fundamental frequency between 200 and 400 vibrations per second

last lamp. In practice the tone is connected to vacant code trunks in the panel and crossbar systems and to vacant local selector levels in the step-by-step system.

The tone is amplified by the vacuum tube T2. This raises the level above that of the dial and busy tones. Relay TO functions as the output transformer. Its output winding has a low internal impedance to allow for large fluctuations in load without appreciably affecting the output level. The potentiometer P3 permits adjusting the output to a satisfactory level. There is a difference of only 7 db between the no-load and the full-load conditions. The amplifier stage also serves to isolate the load circuit from the generating circuit, thereby preventing variations in load impedance from affecting the character of the tone.

To lengthen the life of the vacuum tubes, the plate circuits are closed only when the tone is required. The filaments are continuously heated, however, to maintain the circuit in

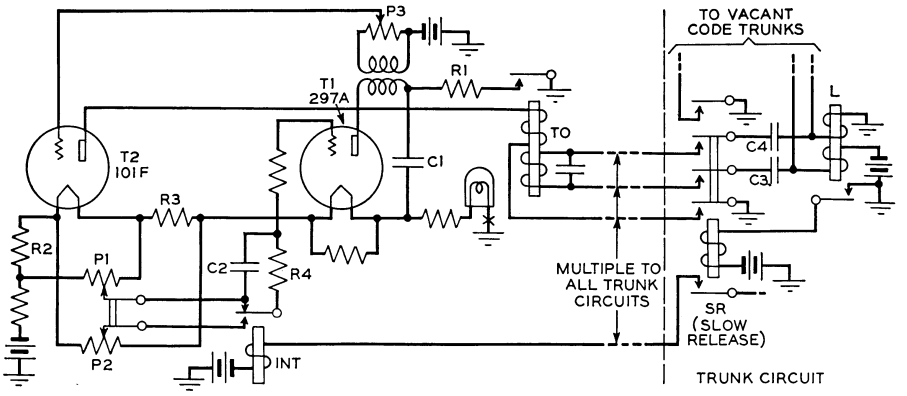

Fig. 3—The tone is generated by a relaxation oscillator which consists of vacuum tube T1, condenser C1, and resistance R1. The frequency of the tone is controlled by the rate of charge and discharge of condenser C2

readiness for instant service. This demand is indicated by the operation of relay SR through the associated relay L. One L relay is connected directly to each vacant code trunk and operates as soon as the trunk is seized. The relay SR releases slowly to hold during dial pulses, if the subscriber continues to dial after the trunk is seized. Operation of the relay SR starts the tone circuit immediately by connecting the plate battery to the vacuum tubes. It also applies the ground pulses to operate the relay INT and cuts the tone through to the associated trunk. The tone is applied to the trunk through condensers C3 and C4 to provide a high tone level and to minimize noise coupling with other circuits. The circuit can supply tone for twenty trunks simultaneously, which is more than will be required for any one central-office unit. Ordinarily one regular and one reserve tone-generating circuit will be provided so that transfer from one to the other can be made in case of failure in either circuit.

"No-such-number" tone is pleasing, yet distinctive and arresting enough to receive immediate attention from the subscriber. During field trials it has reduced circuit holding time on numbers wrongly dialed and resulted in a higher percentage of correct numbers on the second dialing.

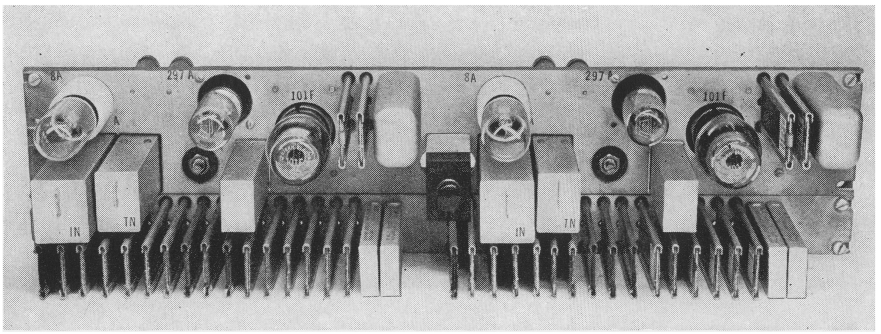

Fig. 4—"No-such-number" equipment warns the subscriber of his error by sounding a distinctive tone. One regular and one reserve generator are provided with a key for transferring from one to the other in case of failure of either