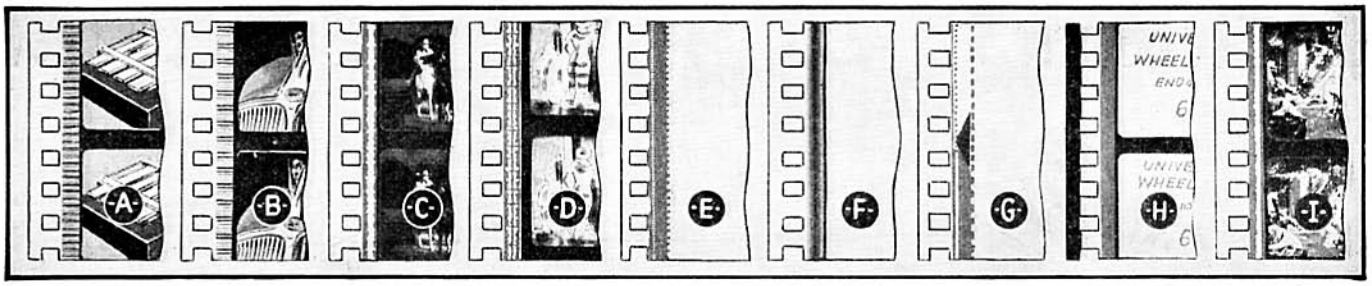

Fig. B. Types of sound tracks; A, variable density, music; B, variable density, speech; C, variable area, speech; D, British spreading speech; E, test film, noiseless; F, test film, not noiseless; G, film splice triangle; H, blank leader, no sound; I, squeeze track.

HOW TO IMPROVE "TALKIES" FIDELITY

This concluding part of the series covers the installation of speakers in theatres, and presents some facts about acoustics.

PART III

LAWRENCE L. JOHNSON

THREE FACTORS govern loudspeaker installation: the frequency range of the speaker; its handling power in watts; and the impedance of its voice coil.

A typical wide-range combination consists of 2 electrodynamic units, one of which covers the low-frequency range from 40 to 4,000 cycles, the other reproducing the range from 3,000 to 9,000 cycles. The high-frequency unit has its own miniature all-aluminum trumpet. The standard electrodynamic unit now being used in the average theater can be replaced with the low-frequency unit as this unit will thread right onto the present air-column horn being used in all theaters where the "pot"-type unit is employed. (Note the number of threads per inch when ordering a unit of this kind.) The high-frequency unit of the combination, having its own trumpet, is simply mounted anywhere in the installation which proves most convenient.

The 2 units of the system are matched by a specially-designed coupling unit furnished with all combinations or where only the high-frequency unit is required. By using a high-frequency unit along with the present unit, and matching the two units with a coupling unit, a very noticeable improvement can be effected in any theater sound installation both in tone quality and frequency response. The reason for this is that, accentuating both the highs and lows, and synchronizing them perfectly, requires cutting off the highs at 4,000 cycles in order to secure proper operation of the high-frequency unit of the wide-range combination.

(You will note that I do not claim a frequency range of from 30 to 12,000 cycles as do some manufacturers of this type of equipment. It is quite possible that a wide-range combination of units with coupling unit to match will reproduce frequencies up to 12,000 cycles, but, inasmuch as no standard recording equipment has been designed which will record such frequencies on film or disc, it is obviously impossible to reproduce them.)

Figure 5A is the characteristic set-up for electrodynamic horn units working from a 500-ohm output transformer. The action of the filter is such that the low frequencies, opposed by the condenser C1, take the easier path through L1, and being met by blocking condenser C2, are forced through the primary of the low-frequency transformer. The higher frequencies take the easier path consisting of the condenser C1, and the high-frequency transformer, and return through the action of C2. In choosing a 500-ohm output transformer for this sort of service, care should be taken that a 15-ohm winding is available to connect the monitor loudspeaker in the projection booth.

Both systems A and B work their filters from an 8 to 15 ohm output transformer. The wide-range filter in Fig. 5D provides a place for a *middle-frequency speaker*, which actually carries most of the load, as the *high- and low-frequency speakers* only appear to talk at intervals.

The filter shown for the *middle* register is actually an autotransformer, and the value (8 mhys.) is only an arbitrarily chosen one, to pass 1,300 c.p.s. This autotransformer action accounts for the loudness the sound system exhibits over the high and low units, although the action of the complete units is that of a band-pass filter. The tapped networks in 5C and 5D are for volume and impedance matching units; these are usually dial switches reading directly in decibels.

ACOUSTIC CONTROL

Sound engineers have learned a great many things since the advent of talkies in 1926. Alteration of the acoustic conditions, generally spoken of as Acoustic Control, has been found not to be all that the theorists prophesied. At first

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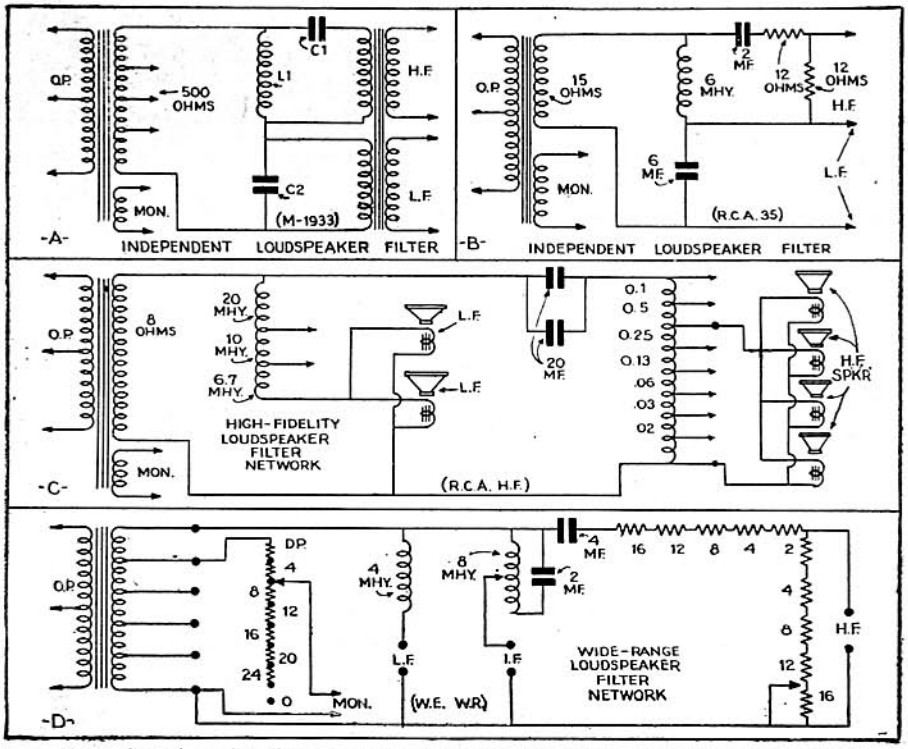

Fig. 5. Several speaker filter networks used in talkies installations; C and D are hi-fidelity.

HOW TO IMPROVE "TALKIES" FIDELITY

(Continued from page 352)

the idea was to have complete dampening of sound similar to broadcast studios. Later developments proved this idea to be in error as a certain amount of liveliness is necessary for natural sound.

The ear does not appreciate flawless acoustics as the sound does not seem natural—"natural" sound therefore is reenforced sound. Too many of the higher frequencies were winding up in deadening acoustic material. Most calculated reverberation times were found to be 15 to 20 per cent too low—particularly Sabine's; later work by Knudsen has shown this, and that any variation of 20 per cent in the derived value is not apt to make any particular difference to the ear.

Tone control, while providing some control of acoustic conditions, has been frowned upon by the exponents of the major sound systems. Tone control is generally disparaged by theoretical engineers but the practical man finds much use for it—providing that it is true tone *correction*. System A says, "leave the equipment alone, improve the house"; system B says, "I don't recommend tone control, but you can alter it by changing wires ABC"; while, the independent engineer says, "leave the house alone," and adds an easily-varied control with the other controls. There is no question that the latter idea has merit in this application but we do not refer to the type of tone control which shunts all of the higher frequencies off to ground; generally, we want an inductance-capacity-resistance network with provision to attentuate either the lower or the higher frequencies.

Attenuation of the lower frequencies offers an obstacle insofar that, since the lower frequencies supply the carrying power, that is the bulk of the volume, a decided decrease in volume is experienced. Recommended theater reverberation times range from 1.1 sec. to 1.8 sec., depending upon the size of the building.

The writer likes a little higher reverberation time than the calculated values as this not only livens things up a bit but helps a lot when the stage is used for vaudeville purposes. The reverberation times for non-talkie theaters runs about 1.5 seconds to 2.75 seconds since a certain amount of reenforcement is necessary, due to the limited power of the human voice.

In connection with acoustic control, we usually recommend the use of "varitone" units. These units permit full frequency control of any A.F. amplifier or receiver. Using this device, tone correction can be effected for defects in acoustic conditions or over-all A.F. response. It is also possible to produce new tonal effects from phonograph recordings or radio reception, and to bring back notes which would otherwise be completely lost. Due to the high equalization obtainable with the varitone, some loss in gain is noticed. If the amplifier or receiver does not have gain to spare, it may be necessary to add an additional stage of amplification in the voltage amplifier where these units should be connected. It is desirable to connect these units at a low-level stage not in the output. Generally speaking, in an A.F. amplifier, they can be connected in any stage except the output stage (as described in a past issue of *Radio-Craft—Editor)*. Special non-variable filters are also available tapped for resonance at either, 25, 50, or 100 cycles. One of these filters will bring up low frequencies to compensate for losses in disc or film recording, and another unit brings up the higher frequencies, tapped for resonance at either 4,000, 6,000, 8,000, or 10,000 cycles.

KENYON ENGINEERING NEWS

"Devoted entirely to the amateur, service engineer, sound technician and experimenter," says Volume 1, issue 1, of this new monthly house organ of a popular manufacturer of transformers and choke coils.

This new publication contains much interesting material in the form of descriptive articles and graphs. The latter, which are devoted in the first issue to decibel conversions to watts, voltage and current ratios, ohms-current-decibels, and ohms-voltage-decibels, are particularly useful to the sound technician and amateur, though the editor, J. B. Carter, promises to run other charts more applicable to the problems of the Service Man, in succeeding issues.

Write for a copy of Vol. 1, issue 1, to *Radio-Craft*—ask for booklet No. 1219.

The next issue of RADIO-CRAFT will contain details of the GERNSBACK 1936 OFFICIAL RADIO SERVICE MANUAL.