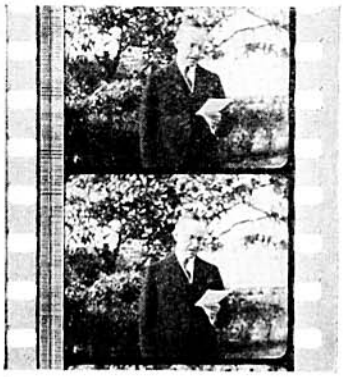
Radio's Husky Offspring— *The Talking Movies*



Fox Movietone variable density sound-on-film

While Not at All a New Discovery, Talking Pictures Were Not Successful Commercially Until Adequate Sound-Amplifying Systems and Suitable Synchronizing Methods, as Developed in the Radio Field, Were Utilized

By Fred A. Jewell*

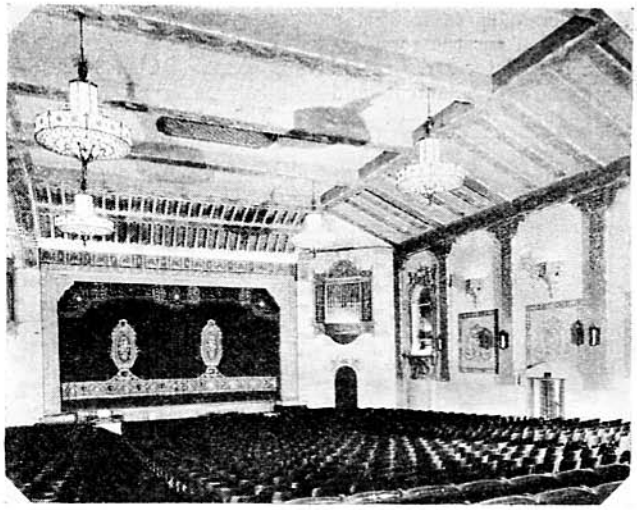
RCA Photophone variable area sound-on-film

In the United States there are 22,624 motion picture theatres, of which 6,929 were wired for sound up to December 15, 1929. Between 50,000 and 60,000 projectionists were employed before the addition of sound. Double that number will be required when all the theatres are wired.

JUST about a decade ago people were asking one another, "What is this radio music everyone is talking about?" Today these same people are taking as a matter of course one of radio's offsprings—the talking motion pictures.

When the "talkies" were first introduced by Warner Brothers on Broadway in 1926 John Barrymore playing in *Don Juan* was as different from his latest talkie, *General Crack*, as your old blooper of the vintage of '21 was from the screen-grid set you finished building last week. True, the voices and music were in synchronism —sometimes—but the reproduction! *There* was something to be wondered at—and apparently avoided wherever possible.

But times change and much water has flowed under the "Bridge of Sighs" (the directors' —sic!) since the days of *Don Juan*. Yesterday is just history in the eyes of the hard-working "sound man" and directors. Today they learn something brand new and tomorrow they will try this new one on the public. However, even though the talking motion picture has been with us for a comparatively short space of time, people all over the world like them better than the "silents."



BECAUSE of the fact that the motion picture industry has been forced to apply the fundamental principles of audio-frequency amplification to a solution of its particular problems, a new field of service opens up to radio-trained men who are skillful in the ways of sound amplification.

To keep pace with the demand for good talkies has not been the simplest of jobs. Well-meaning radio men who have migrated to this new work have felt keenly the need for authoritative information on the subject.

The acoustical properties of theatres (the photo above illustrates a theatre interior treated to obtain suitable sound-absorbing conditions), the particular vagaries of different systems of sound-with-film and synchronization difficulties are all allied subjects which call for an authentic, well-prepared compilation of data. Mr. Jewell is qualified to present this information. In his first article he merely gives the historical background of this new art. Future articles of the series will deal in detail with the various sound systems now in use.

Proof? Just watch the crowds that go to see and hear them. Know any other good reason? We don't.

Historical Background

The first important commercial step in the sound field was the attempt made by Thomas A. Edison over twenty-five years ago. At that time the "flickers," which was what the public had dubbed Edison's pictures, were bad enough, but when sound was added, coming from a tinny phonograph placed behind the screen and out of step with the picture most of the time, the public would have none of it, except as a novelty.

Edison's major problems were: first, that of maintaining a constant speed. You all know how a phonograph sounds when it starts to run down. It is absolutely necessary in the reproduction of sound to maintain a speed that is as nearly constant as possible. Twenty years ago the projectors were driven by a crank manually operated by the projectionist, and it was practically impossible to turn a crank with any degree of constant speed.

The second problem was that of synchronizing the projectors with the phonograph. As the phonographs had to be located behind the screen and the picture projector in the booth, the distance between them presented a problem in mechanics that was never successfully overcome. It was realized that the only successful method for synchronization was to have the driving mechanism for both the projector and the record, on which is recorded the sound, in the booth. Then, of course, the problem of getting the sound back of the screen so that both sound and picture

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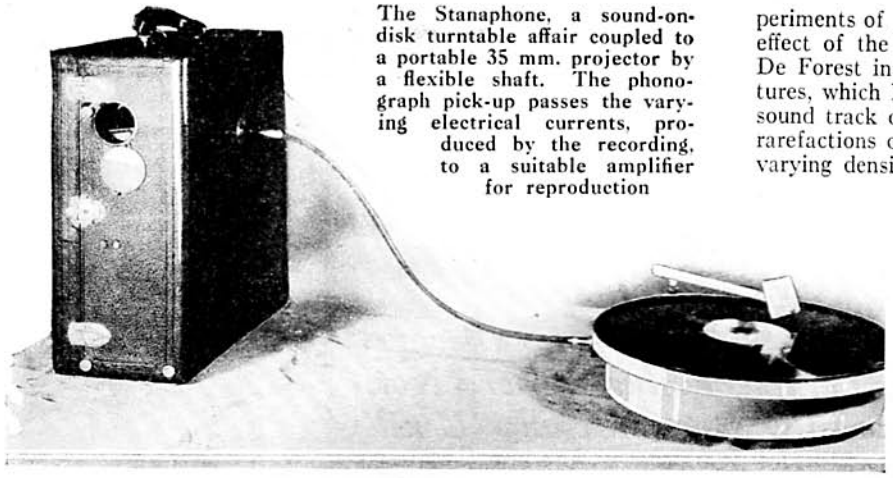


The Stanaphone, a sound-on-disk turntable affair coupled to a portable 35 mm. projector by a flexible shaft. The phonograph pick-up passes the varying electrical currents, produced by the recording, to a suitable amplifier for reproduction

would come from one point, arose and had to be considered.

The third obstacle was to get faithful reproduction of the speech and music recorded out to the audience. It is entirely unnecessary to hold forth here on the type and quality of music and speech that was recorded a few years ago. You all know it was very, very poor.

Even though Edison was far from successful in his first attempts at synchronizing sound and motion pictures, in 1883 he discovered what was the forerunner of the vacuum-tube amplifier, and without this marvelous device sound pictures, such as we know them today, would be impossible.

In 1904 the English physicist, J. A. Flemming, found that a vacuum tube of two elements could be used for the rectification of high-frequency currents, and a little later Dr. Lee De Forest, by introducing the grid between the filament and plate of Flemming's "valve," brought the "heart of the amplifier" to a state of perfection. The work that laboratory experimenters have done in connection with radio in the field of audio-frequency amplification has made possible the talking motion picture as we know it today. Electricity has been applied to the recording and reproduction of "canned" music, and in the booth of the sound-equipped theater the radio experimenter will find apparatus with which he is quite familiar.

How Electricity Aided

It is due entirely to the application of electricity that the problems of early days have been overcome. In those systems employing the phonograph record it is now possible by the use of a synchronous motor to maintain a speed of the turntable that is constant for all practical purposes. The speed of the turntable can be so adjusted that it will run in perfect synchronism with the film. Of course, the synchronous motor, in driving the mechanism of the projector so that the film travels through at the rate of ninety feet per minute, is turning entirely too fast for the turntable, which rotates at a speed of 33 1/3 revolutions per minute. This is equalized by a very intricate set of reduction gears and an ingenious mechanical governor for maintaining constant speed.

The second method of reproducing sound in synchronism with film had as a forerunner the experiments of Alexander Graham Bell on the photoelectric effect of the selenium cell back in 1880. In 1923 Dr. De Forest introduced his system of talking motion pictures, which he called "Phonofilm." This system used a sound track on the film on which the condensations and rarefactions of the sound waves were photographed with varying density and constant width. However, Dr. De Forest was handicapped by the inadequate methods of amplification.

In August, 1926, the Warner Brothers introduced the "Vitaphone" system of synchronized sound-on-disk and film, and the film mentioned in the first part of this article can be said to be the first really successful showing of synchronized sound and motion pictures. In 1927 Fox-Case introduced the "Movietone." This is also the same type of recording as that developed by Dr. De Forest. RCA Photophone is also a sound-on-film system but different from Dr. De Forest's method, in that the sound recorded on the track has a constant density and varying width.

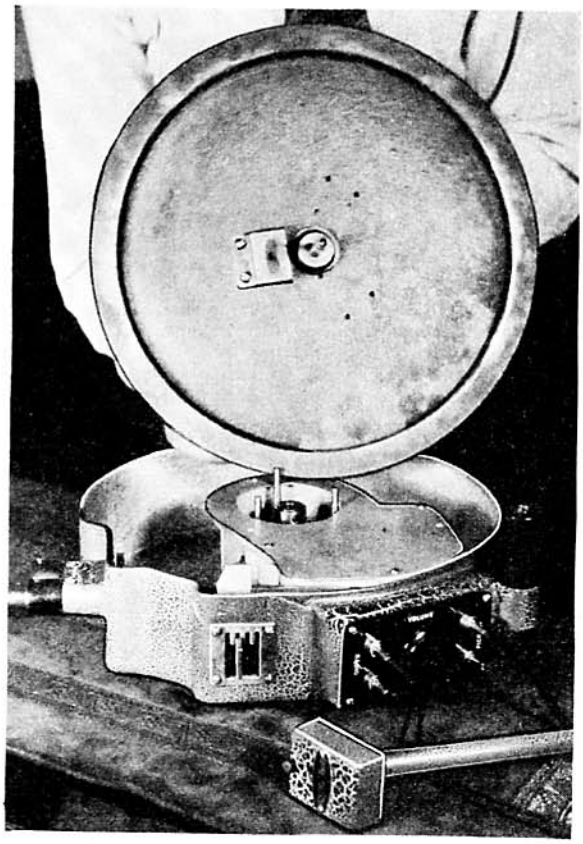
The majority of the installations in the theatres today are equipped to reproduce both of the two methods, *i.e.*, sound-on-film or sound-on-disk. Generally there are two complete projectors in a booth and while one is being run on sound-on-film, for instance, the other can be prepared to follow immediately with the other system. The photoelectric-cell system is incorporated in a housing located immediately under the lenses focusing the picture on the screen. The turntable, with its electrical pick-up, is located on the other side of the projector.

Old Man Acoustics Steps In

These problems, which we have mentioned above and that were overcome by laboratory workers, in turn made new problems for the exhibitors. Theatres that were built especally for the showing of moving pictures were found to be almost totally unfit for the exhibiting of motion pictures with sound. The acoustical properties of moving-picture theatres had not been considered at all when they were built and the result was that in some of them patrons in different parts of these houses could not hear what was being sent to them from the loud speakers. In some cases it was just that in so many words—they could not hear; in other cases reverberation and echoes mutilated the waves to such an extent that the sound which resulted was totally unrecognizable.

Acoustical engineers then came to the fore and by skilful application of different materials to the walls and ceilings of the theatres reduced these troubles to a minimum, and in the theatres that are now being built as much consideration is being given to the acoustical end as was formerly given to the visual.

The following articles of this series will cover the different methods of sound projection and the various ways of eliminating acoustical troubles in theatres. As we said before, the science of sound projection is changing daily; what we set forth as being the latest today may be, perhaps, discarded tomorrow, but the fundamental principles involved (*Continued on page* 1155)



For home talkies. This turntable is provided with a flexible shaft which is connected directly to the driving shaft of the projector, thus obtaining synchronism. A volume control and terminals for amplifier and pick-up are provided

An 80-Meter Installation

(*Continued from page* 1154)

tuner is followed by two stages of transformer-coupled audio-frequency amplification, in which two –12A tubes are employed. As has been explained before, the receiver is turned on and off by means of the change-over switch which is located on the lower part of the panel of the transmitter. Method of connecting the filament circuit of the receiver to the change-over switch is indicated in the circuits of the transmitter and receiver.

Some idea of the general assembly of the receiver will be obtained from the photographs which accompany, while specifications for drilling the front panel and the bakelite pieces for the bases of the shield cans and also the audio unit are contained in Figs. 3 and 8 respectively. Each of the units of the receiver, namely, the r.f. unit, the detector unit and the audio unit, should be assembled and wired separately; that is, one at a time, and then when completed should be wired one to the other to make a complete receiver.

To listen in on the receiver, it is necessary first that the change-over switch of the transmitter be in the "receive" position. Also, the filament switch on the panel of the receiver should be turned to the "on" position. Then, turning the regeneration knob so that the plates of this condenser are completely meshed so as to produce an advanced state of regeneration, slowly turn the tuning dials in easy stages. That is, the dial for the tuned radio-frequency unit should be set at say 50, and then the detector condenser dial should be moved over a small arc at approximately the same position. Then, if no signal is heard at this point the radio-frequency dial should be moved a few more points, either one way or the other, and the swinging of the detector dial repeated. In this way you are sure to cover the entire range of the receiver, working from the low end of the dial to the high end. Of course, it is assumed that previous to listening in, the receiver has been properly connected to its various batteries and the headphones inserted in the phone jack. As a signal is tuned at any one of these settings, a loud squeal will be heard, due to the fact that the regeneration control has been fully advanced. Therefore, to clean up the signal, whether it be code or phone, it is necessary to retard the regeneration control until the squeal disappears. At this point, after the squeal has been eliminated, it may be necessary to retune both the r.f. and the detector dials so as to keep the signal in tune.

For two-way communication, once another station has been picked up on the receiver, it is merely necessary to flip the change-over switch from the "receive" to the "transmit" position.

The parts employed in this portable transmitter-receiver are as follows:

Transmitter Parts

1 Set of tuning inductances (See Fig. 11)
1 R.E.L. r.f. choke coil, L1
1 Amertran audio choke, 30 henries, L2
1 Amertran Deluxe audio transformer, 1st stage type, T1
1 Ferranti transformer, type S57-2, T2
2 Cardwell variable condensers, .00045 mfd., C1, C2
2 Sangamo mica condensers, .00025 mfd., C3, C4
1 Sangamo mica condenser, .002 mfd., C6
1 Ward Leonard resistor, type No. 507, 5000 ohms, R1
1 Yaxley 12 ohm fixed resistor, R2
1 Electrad potentiometer, type E, 0-500,000 ohms, R3
1 General Radio heavy duty rheostat, 2 ohms, R4
1 Carborundum resistor, 12,000 ohms, R5
1 Jewell thermocoupled ammeter, type No. 68, 0 to 1.5 amperes, A
1 Jewell d.c. voltmeter, type 88, 0 to 8 volts, V
1 Yaxley single-circuit phone jack, No. 1
1 Yaxley Junior jack, No. 706
1 Federal anti-capacity switch
3 Benjamin sockets (1 No. 9036 and 2 No. 9040)
2 Four-inch dials
1 Aluminum panel, 16 by 15 inches
4 Brass supporting legs, 6½ inches long by ⅜ inches diameter (See Fig. 12)
Bakelite, 3/16 inches thick for subpanels and connector strips (See Fig. 12)
1 Eureka clip for oscillator coil
2 ft. No. 10 hard copper wire (antenna and ground connections)
Hook-up wire, screws, nuts and washers

Receiver Parts

2 Plug-in coils, type 131V—T1, T2
1 Aero R.F. choke coil, No. 60—R.F.C.
2 Amertran audio transformers, type A.F.8—T3, T4
2 Cardwell taper-plate variable condensers, .00015 mfd., C1, C2
1 Pilot midget variable condenser, .00005 mfd.—C3
2 Flechtheim by-pass condensers, 1 mfd.—C4, C5
1 Sangamo fixed condenser, .00015 mfd.—C6
2 Dejur 5-prong sockets (for coils)
4 Benjamin sockets (subpanel type No. 9036)
1 Yaxley 12 ohm resistor—R1
1 Yaxley 10 ohm fixed resistor—R2
1 Yaxley 1 ohm fixed resistor—R3
1 Aerovox 3 megohm resistor and holder—R4
1 Aerovox 100,000 Metalohm resistor and mount —R5
1 Yaxley filament switch, No. 10
1 Yaxley single circuit phone jack
8 Eby binding posts engraved
1 Panel aluminum, 15 by 8 by ⅛ inches
2 Alco shield cans, 7 by 5 by 6 inches, with cylindrical tops
4 Brass supporting legs, 3½ inches long, ⅜ inches diameter (for coil socket support)
12 Brass supporting legs, ½ inch long, ⅜ inches diameter (for shield can subpanel spacing)
Plywood baseboard, hook-up wire, screws, nuts and washers
1 Audio channel bakelite subpanel, insulation strips, etc.

The above are the components that were used by the author. However, any others having similar electrical and physical characteristics may be substituted.

Radio's Husky Offspring

(*Continued from page* 1118)

do not change, and we intend to deal mainly with these.

The combination of sound and motion pictures is so new and the public demand so great that the results up to very recently have given a wrong idea of the possibilities that exist. That some sound pictures have been poor there is no doubt, but diligent investigation and research by competent radio engineers who have gone over to the sound field indicate that better sound reproduction is in store. It is the same condition that existed in the radio field six or seven years ago. Everybody from the man "on the lot" to the projectionist in the booth has had to learn a new job, and we venture to say that before very long it will be possible to enjoy the talking motion picture as much as a play presented on the stage today.