

Injustice of the patent system—one scientist's story

In view of the interest in patents, as evidenced by the symposium "Patents—The Other Way to Publish" at the past Washington meeting, it may be of interest to mention the patent troubles of an outstanding radio engineer and at the same time to correct the statement of Heinrich Welker in his obituary of Walter Schottky (June 1976, page 63) in which he gives Schottky credit for the superheterodyne principle of amplification.

GUEST COMMENT

by

Howard L. Poss

The complexities of patent law and the large financial considerations that may be at stake serve to ensure that just about any basic patent is likely to be contested. The difficulties encountered by the independent inventor are especially severe in patent litigations when he finds himself pitted against the resources of a large corporation.

The case of the superheterodyne is one of the relatively tranquil events in the tragic career of Edwin Howard Armstrong (1890–1954) in the sense that his claim was not vigorously contested. He clearly conceived this idea on his own while serving in the US Army Signal Corps in France during World War I. He was faced with the problem of designing a radio receiver that could detect weak signals up to frequencies of several megahertz and which could be tuned easily while maintaining its selectivity and sensitivity. These specifications were far beyond the receivers then available. In Armstrong's words:¹

During the early part of 1917, I had made a careful study of the heterodyne phenomena and their effect on the efficiency of amplification. With this work freshly in mind, the idea occurred to me to solve the problem by selecting some frequency which could be handled by the tubes available, building an effective amplifier for that frequency, and then transforming the incoming high frequency to this readi-



ly amplifiable value by some converting means which had no low limit; preferably the heterodyne and rectification.

A patent covering his invention, dated 30 December 1918, Paris, France and filed 8 February 1919 was granted US Patent no. 1 342 885 on 8 June 1920.

In 1941, the Franklin Institute, on the recommendation of its Committee on Science and the Arts, awarded its highest honor, the Franklin Medal, to Armstrong (the other recipient that year was C. V. Raman). The citation recognized his development of the regenerative circuit and vacuum-tube oscillators, the super-regenerative detector, the superheterodyne, and wide-band frequency modulation. In regard to the superheterodyne, the committee report stated:

For completeness, the work of contemporaries, which occasioned some patent interference, is mentioned. Lucien Levy of France, Walter Schottky of Germany, and Lloyd Espenschied of the United States all devised systems having some general resemblance to the conception of Armstrong. An examination of these confirmed the final opinion of the

United States Patent Office that they do not really constitute an interference. The evidence clearly indicates that Armstrong understood the difficult problem and its pitfalls. His solution resulted in the invention of a most valuable contribution to the art of communication—the superheterodyne circuit, which is found in about 98% of the millions of broadcast receivers in use today.

The legal entanglements surrounding his other achievements were much more severe. The regenerative circuit was contested by Lee deForest, inventor of the triode. Armstrong had developed the concept while he was a student at Columbia. Part of his troubles were caused by the refusal of his father to advance him the money that would have enabled him to file a patent at an early date. In litigation extending over many years, the US Supreme Court finally decided in favor of deForest in 1934. Armstrong then attempted to return the Medal of Honor awarded to him for his invention by the Institute of Radio Engineers in 1918, the first such medal that the Institute had awarded. The Institute refused to take the medal back on the grounds that the priority and understanding of the concept clearly belonged to Armstrong. DeForest had tried to suppress feedback oscillations when they showed up in his equipment and neither understood their cause nor appreciated their utility.

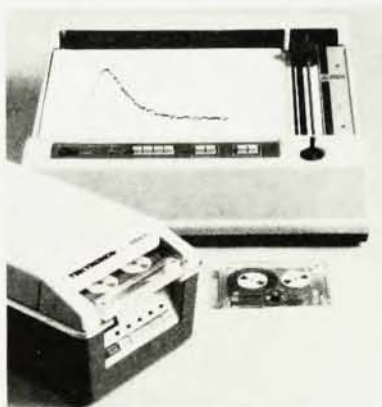
Armstrong's last major contribution, wide-band FM, was first ignored by the radio industry, which had a substantial investment in the growing field of AM broadcasting. Armstrong had been seeking a means to overcome static by developing a communications system immune to its effects instead of following the conventional path of increasing transmitter power and decreasing receiver bandwidth. Using wide-band frequency modulation for the transmitted signal and a receiver insensitive to amplitude variations for signals above a given threshold, he not only eliminated static for practical purposes, but came up with a high-fidelity system far beyond the reach of conventional AM. With money earned from previous inventions, he developed the necessary circuits and built and main-

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letters

tained an experimental FM transmitter located in Alpine, N.J. Following World War II, the radio industry turned to television and looked covetously at the FM band as being a spectral region that could be more usefully converted into several TV channels. The FM band was in fact incongruously relocated to its present position in the middle of the current VHF television band. An unexpected bonus (?) of this transfer is that an FM receiver can pick up the audio signal of television channel 6 at the lower end of its frequency range. (Television uses frequency modulation for the transmission of the audio signal.)

When the industry finally realized the merits of Armstrong's FM system, they sought to circumvent his patents. In February 1954, physically and emotionally drained by his ongoing court battles with RCA, Armstrong plunged to his death from his New York City apartment. One of his friends estimated that during the last years of his life, Armstrong had probably spent 90% of his time on court actions.

A sympathetic but perceptive biography of Armstrong has been written by Lawrence Lessing (Lippincott, 1956).

I appreciate the courtesy of Edmund Thelen and Catherine Earl of the Franklin Institute in making the Committee Report available to me.

Reference

1. E. H. Armstrong, Proc. I.R.E. 12, 540 (1924).

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Refuting relativity?

I should like to add a few comments to the recent interesting article by Beatrice Tinsley, "The cosmological constant and cosmological change" (June, page 32). My comments are only in regard to the possible role of the theory of general relativity in the cosmological problem.

A question addressed by Tinsley was: Is the universe expanding in a single outward motion of ever decreasing matter density, or will it turn around at some critical point to start a collapse inward? My main comment is that her conclusion, that the single big-bang model is most likely correct in accordance with the data, is (admittedly) model-laden, and that it is also based on a very restricted view of precisely what the theory of relativity is.

The model that Tinsley refers to (the "Friedman models") assumes a number of underlying axioms that go beyond the requirement of the theory of general relativity. These are the axioms that are generally required to derive the Robert-

son-Walker-type metric. It is assumed that the matter distribution of the universe is spatially isotropic and homogeneous (the "cosmological principle"), and restrictions are imposed on the metric that yield an absolute global time measure. That is, one assumes at the outset that the time measure from any galactic frame is the same—even though all galactic frames are accelerating relative to each other in accordance with the Hubble law. This "global time measure" is then supposed to be a measure of the evolution of the universe as a whole.

The implication of the restriction of an absolute time scale is an incompatibility with the principle of relativity. This principle generally requires that any given temporal measure, from one frame of reference, would be some prescribed alteration of the space-time measures from other relatively moving frames, in accordance with the transformation group of general relativity. The non-covariance of the absolute global time measure may also be seen from the incorporation in this model of the Hubble law, $H_0 = \dot{R}_0/R_0$ —which in itself is a non-covariant equation of motion of a star.

A tacit assumption in Tinsley's article is that the theory of general relativity is uniquely represented by Einstein's tensor equations, precisely as he wrote them. Einstein himself emphasized that "not for a moment, of course, did I doubt that this formulation was merely a makeshift in order to give the general principle of relativity a preliminary closed expression. For it was essentially not anything more than a theory of the gravitational field, which was somewhat artificially isolated from a total field of as yet unknown structure."¹

The principle of relativity is the assertion of the objectivity (covariance) of all of the laws of nature with respect to the space-time transformations between relatively (generally nonuniformly) moving reference frames. Thus, the variation of G , or the incorporation of a cosmological constant, or not, into the formalism relating to cosmology, would not invalidate Einstein's theory—even though it may not fit his particular (preliminary) mathematical expression of his theory—so long as the general field equations would remain covariant.

It follows that the only cosmological model under current consideration by astronomers that is truly compatible with the principle of general relativity is the oscillating model of a closed universe. But it must be required further that observers on different galactic frames would not agree on the quantitative time measure, say since the beginning of the latest expansion cycle. What it is that general relativity theory demands they agree on is the form of the laws of nature—thus the qualitative oscillating nature, expansion $\leftrightarrow$ contraction, of the universe as a whole. I would then interpret a conclusive

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