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**A STUDY OF THE OPERATING CHARACTERISTICS OF THE
RATIO DETECTOR AND ITS PLACE IN RADIO HISTORY**

By

**Dr. Edwin H. Armstrong,
Professor of Electrical Engineering, Columbia University**

THE RADIO CLUB OF AMERICA

11 West 42nd Street ★ ★ ★ New York City



A METHOD OF REDUCING DISTURBANCES IN RADIO
SIGNALING BY A SYSTEM OF FREQUENCY
MODULATION

To Charles A. Underhill
in remembrance of those days
at Pine Crest where he taught
the writer the mechanics of
the electric circuit.
Edwin H. Armstrong

BY
EDWIN H. ARMSTRONG

To the man whose
assistance in the bank
ages of 1908 laid the basis
of this invention - my
friend Mr. Charles A. Underhill
with sincere regards
March 20, 1922: E. H. Armstrong

United States Circuit Court of Appeals
For the Second Circuit

**EDWIN, H. ARMSTRONG AND WESTINGHOUSE ELECTRIC &
MANUFACTURING COMPANY,**

Plaintiffs-Appellees.

against

DEFOREST RADIO TELEPHONE & TELEGRAPH COMPANY,

Defendant-Appellant.

**Opinion of Court of Appeals in "Armstrong Feed-
Back Circuit" Case on U. S. Patent No. 1,113,149.**

PENNIE, DAVIS, MARVIN & EDMONDS,

165 Broadway, New York City.

Solicitors for Plaintiffs,

THOMAS EWING,

WILLIAM H. DAVIS,

W. BROWN MORTON,

WILLIS H. TAYLOR, JR.,

of Counsel.

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WOULD LIKE YOU TO ATTEND AS MY GUEST MY LECTURE ON FREQUENCY
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COLUMBIA UNIVERSITY PLEASE WIRE ME IF YOU CAN COME =

ARMSTRONG

211 CENTRAL PARK WEST.

609P.

Edison Medal Presented to E. H. Armstrong

with the compliments of the medalist to the man who taught him radio.

The 1942 Edison Medal, highest award of the AIEE, was presented to Edwin Howard Armstrong, professor of electrical engineering, Columbia University, New York, N. Y., at a special session of the AIEE national technical meeting on January 15, 1943. Text of presentation address and response of medalist follow.

E. H. Armstrong—Edison Medalist

ALAN HAZELTINE, Fellow AIEE

If we review the advances in electrical technology in the past 25 years, one development stands out from all others—electronics, and specifically the application of the three-electrode vacuum tube. It is appropriate to recall here that the original electronic tube was the two-



Edwin H. Armstrong, 1942 Edison Medalist

electrode tube of Edison, in whose honor the Edison medal was established. Others subsequently applied this "Edison effect" in radio detection and introduced the control electrode, but the action was viewed as that of a trigger, as in the modern thyatron, which is of limited application. The real foundation for the unlimited development which we have witnessed was laid by the Edison Medal recipient, Doctor Edwin Howard Armstrong, in an article published in the *Electrical World* in December 1914. Here the common engineering tool, the characteristic curve, was employed for the first time to show how the tube amplifies; and the theory was sub-

stantiated by oscillograms which Armstrong had taken. The previously mysterious action of the tube as a rectifying detector with a grid capacitor was elucidated in the same way.

I well remember the impression this article made upon me at the time, and the conviction that here was something with great possibilities. I also remember the excitement produced a few months later by Armstrong's first paper before the Institute of Radio Engineers on his feed-back circuit, which employed this theory to give undreamed-of amplification of weak radio signals and permitted the general use of heterodyne reception by providing for the first time a source of continuous oscillations of frequencies as high as any then used for radio transmission. May I take this occasion to note that these publications of Armstrong started my own work in radio and profoundly affected my subsequent career, as they have affected the careers of many others?

It is rather hard now to take ourselves back to conditions in radio prior to Armstrong. Attempts were being made at transoceanic telegraph communication, but with only very restricted success, even with enormous receiving antennas and elaborate commercial apparatus. The radio amateurs, who shortly were to be the mainstay of Signal Corps and Navy radio in World War I and were later to supply the radio engineering talent called out by broadcasting, could receive only local signals. Armstrong's work removed the barrier to regular long-distance radio telegraphy. By increases in power of the vacuum tubes, it also provided an easily modulated high-frequency source for radiotelephone transmitting, so that long-distance radiotelephony soon followed. And then came the great broadcasting development with its far-reaching social consequences.

The early work of Armstrong, the experimental part of which was done while he was still an undergraduate at Columbia University, soon received recognition. Its importance was appreciated by Professor Pupin, who took Armstrong under his wing. Together they carried on several researches in radio. In 1917 the Institute of Radio Engineers awarded its Medal of Honor to Armstrong for the feed-back circuit, the presentation being made by Professor Pupin, then president of that society. I recall a remark of Professor Pupin on that occasion: that inventions are sometimes ascribed to luck, but that the best luck is to have a good head on one's shoulders! The correctness of Pupin's appraisal has been demonstrated amply by Armstrong's subsequent career.

In this period, the question of amplification due to heterodyne reception was in dispute. Armstrong clarified the matter in a paper presented to the Institute of Radio Engineers in 1916. Doubtless this study paved the way for Armstrong's next important invention, the super-

Alan Hazeltine is professor of physical mathematics at Stevens Institute of Technology, Hoboken, N. J.



The Ambassador

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January 27, 1943

Dear Reg:

I thought you might
be interested to know that I
am the guest of Harvard
Crestmont who receives
the Edison Medal - the
highest award - at the
Engineers Society's building
this evening. Marguerite
will dine with us here
tonight. It's banking night.
Will hurry home tomorrow
so mother will ^{not} have to do any
heavy cleaning. She is fine.

Love to all of you.

Lead.