RADIO

"Phase Modulation" Radio Cannot Be Jammed By Enemy

In Phase Modulation, PM, Two Carrier Waves of Same Frequency Are Used; Reception Controlled by Phase

A NEW system of secret radio communication that cannot be jammed by a carrier wave of identically the same frequency, which might be put out by hostile persons for that purpose, has been invented by John Hays Hammond, Jr., of Gloucester, Mass., well-known pioneer inventor of remote radio control devices for vehicles, airplanes, ships and submarines. Mr. Hammond has been awarded patent 2,272,839 on this device.

The jam-free character of the system is obtained by a new type of modulation called "phase modulation," which is entirely different from either amplitude or frequency modulation. In other words, to the familiar AM and FM we must now add PM.

In AM, as is well-known, the amplitude, or what might be called the height of the radio waves, is modified in accordance with the ups and downs of the voice. In FM, the frequency is modified in the same way.

In phase modulation, PM, two carrier waves of the same frequency and amplitude are required because a phase shift or a phase difference means that one wave starts a little ahead of or behind the other. If the two waves start together, they are in step or in phase; there is no phase difference. If both are picked up by the same receiver, the effect is double that of either alone.

If one wave is shifted a half wave length with respect to the other, then the crest of one corresponds with the trough of the other and the effect on the receiver is nil. There are of course all stages of phase difference between and beyond these two, with all degrees of loudness in the receiver from maximum to zero.

Any radio receiver, tuned to the frequency employed, could pick up these waves and experience the variation in loudness due to phase shift that has been described.

Secrecy and freedom from interference are obtained by Mr. Hammond by polarizing the two waves, which his transmitter sends out, in planes at right angles to each other.

To use the analogue of mechanical vibrations, one set of waves might be vibrating up and down while the other is vibrating horizontally from side to side.

These two waves, superposed, never completely annul each other, whatever their phase relations. If they start in step, the resultant is a vibration in a direction inclined at an angle of 45 degrees to the vibration directions of each of the component waves—halfway between them, so to speak.

In the simplest form of Mr. Hammond's invention, the receiving antenna is a rod that can be inclined at various angles. Under the conditions just described, the maximum effect would be received when the rod is inclined at 45 degrees. Nothing would be received at right angles to this position. If a third wave of the same frequency were put out by some hostile person with the intention of interfering, the only effect would be to shift the angle at which maximum reception occurs. The operator could soon find the new position.

In a more complicated form of the invention, which makes for complete secrecy, the same two waves, plane polarized in directions at right angles to each other, are put out, but one is shifted a quarter of a wave length (phase difference) with respect to the other. Reverting to the mechanical analogue, the resultant wave is then no longer one that is vibrating in a diagonal plane, but one whose particles describe circles in the right-handed or clockwise direction. If the phase is now shifted another half wave length (three-fourths of a wavelength in all), the motion is in left-handed circles. These are called circularly polarized waves.

The receiver is arranged to distinguish between these two waves, circularly polarized in opposite directions. This, no ordinary receiver can do. A telegraph key is arranged merely to shift the phase difference back and forth a half wavelength. One position may represent a dash, the other a dot, both being of equal duration. If any unauthorized receiver did pick up some response, there would be no difference in sound for either position of the sending key—just a continuous, meaningless succession of dah, dah, dah, dah.

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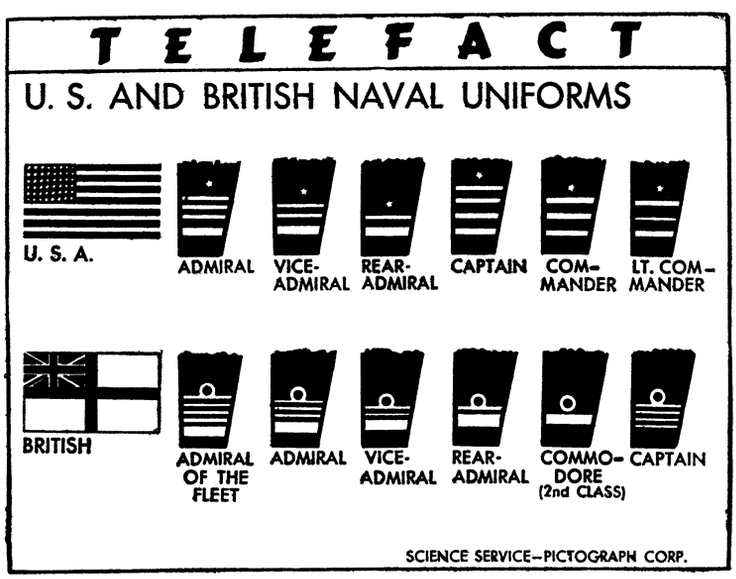

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Saturday, February 28, 1:30 p.m., EWT

On "Adventures in Science," with Watson Davis, director of Science Service, over Columbia Broadcasting System.

Dr. Morris Meister, principal of the Bronx High School of Science, will tell how high school science clubs can aid in the war effort.

Listen in each Saturday.

Tuesday, February 24, 7:30 p.m., EWT

Science Clubs of America programs over WRUL, Boston, on 6.04 and 11.73 megacycles.

One in a series of regular periods over this short wave station to serve science clubs, particularly in high schools, throughout the Americas. Have your science group listen in at this time.