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The Beginnings of Air Radio Navigation and Communication

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I congratulate my friend Brian Kendal on his succinct exposition in the January issue on Air Radio[1]. However there is one rather important point I feel should be made since the *Journal* is regarded as a "Journal of Record". He says (p162) that Fessenden's patent can be considered "*the first suggestion for*....." and (p167) "*the basis of*...." hyperbolic wireless navigation systems.

The Fessenden patent (the original is US 236861 of Dec. 4th, 1904) consisted essentially of a description of how distance from a radio transmitter might be obtained by measuring signal strength. He proposed several transmitters be set up and transmit in turn in such a way that a marine navigator might obtain successive ranges from them, the intersection of these ranges giving him his position. As Brian says, the impractibility of relying on signal strength for this purpose was not then fully appreciated, combined with the mathematical fact that the logarithmic fall-off in strength meant that at anything other than very short ranges quite small differences in strength would mean comparatively large distances. Those factors alone made Fessenden's idea infeasible and it was never taken up. The relevant point here is that Fessenden was not proposing a hyperbolic system and did not claim so. Ranges obtained as Fessenden described are circular in form, one transmitter providing a single line of position – a modern parallel being DME. The second LOP required to obtain a fix must be obtained from another source, perhaps another transmitter of the same type, (as Fessenden proposed) but (and this is the important point) it does not necessarily have to co-operate with the first one in any way, or even use the same method of measurement. Direct range measurements of this type require either that transmitter and receiver independently maintain a very high degree of timing stability, or that some sort of round-trip measurement is made, like radar. Fessenden thought he could assume the first of these, and unfortunately was wrong.

It was because the techniques of the day did not permit either the timing stability or a round trip measurement that hyperbolic systems began to be proposed in the late 1920s. If two transmitters make their transmissions in synchronism, then if a receiver measures *the difference* in arrival time of the two signals, the instabilities in transmitters and receiver will be eliminated. The shape of the resultant position line is then a hyperbola, hence the name. I happen to have a copy of Fessenden's patent and

nowhere is there any mention of measurements being made this way. Clearly his system was not a hyperbolic system and therefore cannot be claimed to be a forerunner of them.

According to Powell[2] the first genuinely hyperbolic system described in a formal patent was that of the Frenchman H.M.A. Mottez in 1923 which slightly pre-dated that of the American H.A. Affel in the same year. Mottez gave a full description of how hyperbolic patterns resulted from his use of three transmitters and the advantages thereof and must be considered as the first real progenitor of hyperbolic systems. Fuller details of these, and several other early hyperbolic systems, were given in Powell's paper, which was reproduced in the book *Air Navigation from Balloons to Concorde*[3] (Woodfield, 2005) edited by myself.

REFERENCES

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3. Blanchard W., (Ed) (2005). *Air Navigation from Balloons to Concorde*, Woodfield Publishing Ltd.