

The Story of Amateur Radio Teletype

An Insight into a Fascinating New Branch of Ham Radio

BY JOHN EVANS WILLIAMS, * W2BFD

FOR several years prior to the war we were very much interested in carrier current¹ or "wired wireless" over distances longer than the in-the-building circuits that amateurs had used in the past. The idea was to use carrier current for voice feed and remote control of the W2BFD half-kilowatt 20-meter 'phone rig which was located about six-tenths of a mile from home. Voice relay was 100 per cent solid but transmitter control would suffer occasionally when a heavy power leak would turn on the transmitter — a most undesirable state of affairs. Positive control was finally achieved by the use of an intricate coding system which required the dialing of four digits prior to the dialing of the code for turning on the transmitter. However, this system was regarded as too complicated and so many simpler schemes were being mulled over in our mind when World War II came along.

As was the experience of many amateurs, war work brought us into intimate contact with many projects of "hush-hush" nature. Gained was an inkling of the workings of a "magic" new transmitting system, f.s.k.,² which was tolerant of noise and fading to a remarkable degree. Here at last, it was thought, was the ticket to simplified

*% The Electronic Device Co., 38-06 61 Street, Woodside, L. I., N. Y.

¹ J. E. Williams, "'Wired Wireless' for Remote Control," February, 1940, *QST*.

² Grammer, "Frequency-Shift Keying," Technical Topics, June, 1946, *QST*.

• The mail has been heavy at W2BFD ever since March *QST* made casual mention, in conjunction with his converter article, of Mr. Williams' interest in amateur teletype. To rescue W2BFD from the throes of writer's cramp and at the same time record an interesting bit of amateur radio history, here is the background on TT as recounted by the man who should know.

remote control. By 1944 a subcarrier f.s.k. unit — differing from true f.s.k. in that a frequency-shifted a.f. oscillator modulates a fixed-frequency r.f. carrier — was in two-way operation at W2BFD on the power-line carrier apparatus, making transmitter control in every sense the equal of a wire circuit.

In the early summer of 1945 Al Waring, W2CFT, dropped into the shack and surprised us in the act of connecting our f.s.k. receiving equipment to the output of a communications receiver. Commercial f.s.k. signals were tuned in and the loudspeaker turned off. Al, a CAA technician with an extensive knowledge of landline teletype, exclaimed, "John, the clicking of that polarized relay sounds exactly like the rhythm of the relays over at CAA. I'll bet that stuff would type if you had a printer here!" In such a simple manner amateur teletype was born. To W2CFT must go the credit for starting us off. He is the "Patron Saint" of ham teletype!

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Home from Yale for the weekend, Renville H. McMann, jr., W2PCD, New York City, drops in on the V.H.F. Teletype Society Net for a rag-chew. When classes permit, Ren is one of those active in building equipment for a proposed extension of the Net into Connecticut, using automatic-relay stations. The projected link would tie into the New York end at W2MXJ, Bayside, L. I., cross Long Island Sound to W1OHH, New Haven, and continue through intermediate stations to W1AW, Newington.

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QST for



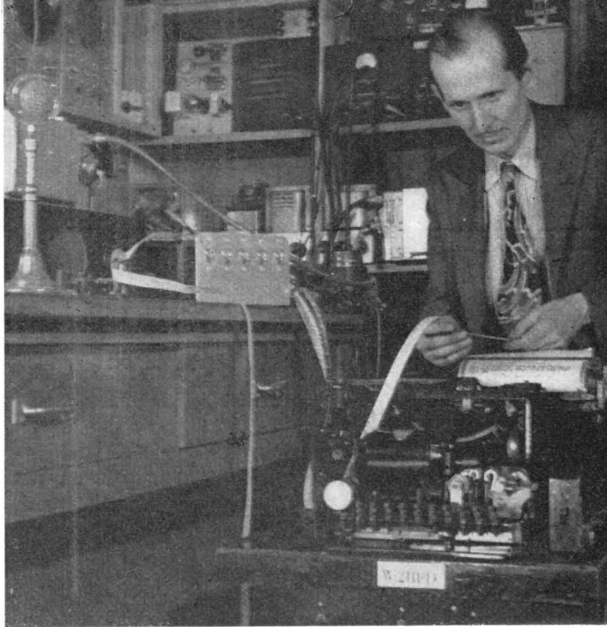
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The author runs a test on the W2BFD teletype, using a high-speed-printer tape "transmitter" for signal source. [An experimenter-type ham, W2BFD was using single-side-band 'phone back in the Thirties when most of us were putting in Class B. — Ed.]

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Always ready to help, W2CFT put us in contact with a CAA teletype repairman who had heard talk about a batch of printers that had belonged to the old Postal Telegraph Co. and which had been taken over by Western Union. The report had it that they were heaped in a warehouse in Brooklyn, unused. At that time Gus Rinninsland came into the picture. Although not an amateur, he had been interested in various phases of radio for over twenty years. When he saw what was being accomplished in f.s.k. and what was needed for amateur teletype, he threw himself wholeheartedly into our project. At times taking time off from his regular work, Gus followed leads all over New York and New Jersey in an effort to secure teletypes for us. Heartbreak followed the breaking-off of negotiations with WU when that company decided they would need the old Postal Telegraph machines in other fields. Similar negotiations to procure a second batch located in Jersey City failed too. But Gus would not let us drop the matter. His enthusiasm and continual friendly "heckling" resulted in our locating, through connections developed as an old-time wire telegrapher, two companies that would dispose of their machines for much less than had been anticipated, provided it could be guaranteed in writing that the machines would remain in amateur hands (more about this later). Needless to say, Gus has mastered the code and is now ready to go up for his ham ticket.

In May of 1946 the first two machines were received and within three hours of the time they were unpacked one was connected to the f.s.k. panel and a commercial radioteletype station tuned in. It was a dramatic moment when, after a few false starts, the printer burst into a rhythmical 65-w.p.m. pounding-out of a perfectly-typed message saying . . . ah, sorry, OM, but the secrecy provisions of the Communications Act prevent us from telling you, so that is one part of amateur radio teletype history you will never know! . . . The fascination of seeing this "iron horse" clip out the words with never a moment's hesitation from the tape-operated commercial teletype stations all over the world will never wear off. The machines are positively uncanny!



That settled it. If commercial high-speed stuff could be copied solid, then it would be a cinch to record amateur transmissions. A one-way circuit on 2 meters was arranged between W2BFD and the homes of several friends, including W2BDA, W2AUF and ex-F8JM (now an American citizen and awaiting his W call). A blight fell on our little group when our CAA friend, W2CFT, was transferred to Paris to supervise radio-teletype installations at Orly Field. However, Al is back with us again and located at MacArthur Field here on Long Island.

The circuits worked right from the start, so a crude and not very effective automatic starter unit (a.s.u.) was schemed up to keep the printer motors off until a signal was received. A rather humorous sidelight developed when the printer installed in a closet in the home of one of the gang started up at 3 o'clock one morning with a loud clatter. He swears to this day that it was done deliberately but of course we wouldn't believe that, would we?

The first two-way amateur radio teletype QSO of record took place between Dave Winters, W2AUF, Brooklyn, and W2BFD, Woodside, L.I. It was not witnessed by any other amateurs but it will be a long time before either of us gets a bigger thrill out of ham radio. At that time Dave had pressed into service an Abbot TR-4 to do the transmitting job and outside of the drifting, which required retuning of the W2BFD receiver every few minutes, the Abbot made a good showing for itself. An unexpected dividend of using subcarrier f.s.k. on a modulated-oscillator transmitter was realized then. The dynamic instability which always accompanies varying voice modulation is totally absent with this system, although the center-frequency drift is still there. With a.f.s.k. the modulation is always close to 100 per cent and only the pitch changes, so the in-

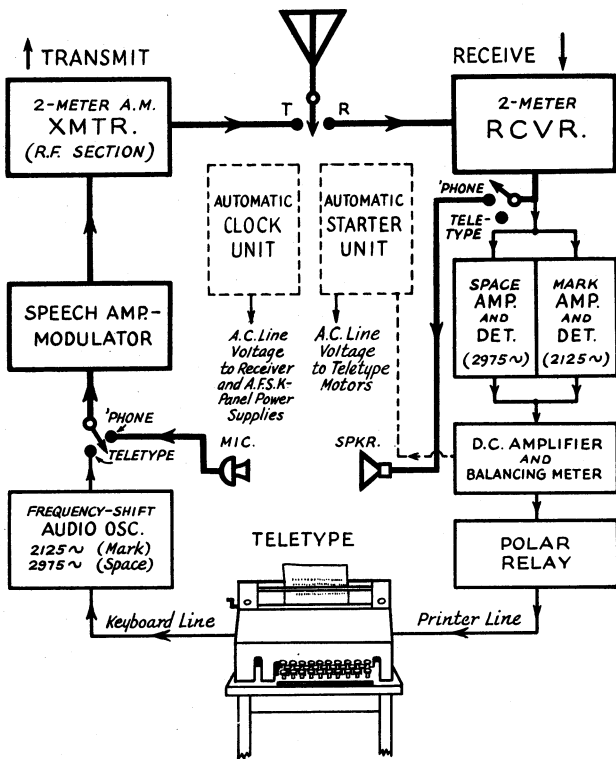


Fig. 1—Audio f.s.k. teletype system used by members of the V.H.F. Teletype Society of N. Y. Net. Bold lines represent a typical 2-meter 'phone-station installation (usually a 522 with crystal-controlled receiver and transmitter), while the medium lines show how the various a.f.s.k. units and the teletype machine fit into the over-all station pattern. The automatic clock and starter units (light dashed lines) are optional and required only when unattended message receiving is desired. Coupling between the frequency-shift audio oscillator and the space and mark amplifiers actuates the receiving-printing circuits and thereby makes it possible to monitor visually all keyboard operation.

Since a.f.s.k. is relatively uncritical as to carrier or receiver drift, it is especially adapted to v.h.f. applications. For true f.s.k., wherein the r.f. carrier is shift-keyed, the receiving set-up shown above need not be changed except for the addition of a receiver b.f.o.

stability is not manifested on a type of modulation where the amplitude never varies.

Shortly after this first two-way contact Bill Fisher, W2MXJ, Bayside, L.I., came on with teletype, contributing many hours of pioneering work to our new activity. Incidentally, Bill is one of the most active v.h.f. teletype stations on the air today, and is still trying to convince the rest of us that TT should go horizontal on antenna polarization.

During these early days of teletype on the ham bands, we made it a practice to close each QSO by switching to voice modulation and giving the station call and a description of what was being done. This helped to dispel the fear amateurs were expressing that one of the Press Wireless stations,

not too affectionately known as "Jingle Bells," had invaded the band. This vocal explanation or "advertisement" brought astonishing results because in a short time amateurs from all over the metropolitan New York area were calling and writing to find out how they could get into this fascinating new angle of their hobby.

As might be expected, there also was some lack of understanding by a number of amateurs who felt that 'phone operation on the 2-meter band was being threatened. It was not unusual to overhear an amateur saying that TT was "as broad as a barn" and that we were trying to make two meters an exclusively-teletype band. Nothing could be farther from the truth. Frequency-wise, the approximately 6-kc. (not Mc.) bandwidth (carrier ± 2975 -cycle space frequency) of teletype is not as broad as the majority of 'phone stations. The impression of teletype's extraordinary loudness is gained because a.f.s.k. permits a higher average level of carrier modulation (for the same reason progressive 'phone operators use speech filters and clippers). As for TT giving 'phone any serious competition: What amateur would want to type out his rag-chews by the hour when he could have his say more naturally and quickly on voice? And to set the c.w. man at ease, we might add that teletype circuits are purely electro-mechanical in nature; the teleprinter machine has no reasoning faculties which in times of hard going can substitute for the intuition and gray matter of a trained c.w. operator. Amateur teletype is primarily a means of printed-record com-

munication, with the highly-desirable extra feature of allowing a message to be delivered at any time on an unattended printer at the station of destination.

Teletype is an enthralling field for the technically-minded amateur. Such was the case with Renville McMann, W2PCD, a Yale student, who learned of TT during a rag-chew. It was not long before Ren joined our group, followed in short order by his close friends, Alexander ("Sandy") Proudfit and Lee Nettleton. W2PCD came on the air with teleprinter within a few days of the time he received his machine and has since done extensive work with RC filters and Navy-type FRA f.s.k. converters. Sandy has pitched into the battle of licking our numerous technical problems,

drawing on his wide engineering experience to help in the perfection of our present sure-fire automatic starter unit. Lee, also at Yale, will uphold the Cheshire, Conn., leg of a proposed automatic-relay TT net into Connecticut.

October of last year saw the first reliable automatic relaying operation accomplished on TT. Although over a short distance, it enabled two stations (one a transceiver) to communicate with one another when they were unable to hear each other direct. This circuit was from W2AUF to W2BFD to W2PCD and return. It was followed by many longer and more complex relays, and though our stations are highly concentrated, transmission paths up to 200 miles have been covered. Net members are now anxiously awaiting completion of amateur-teletype outlets in Connecticut (W1OHH, W1AW, W1INF), Pennsylvania (W3POW), and the District of Columbia (W3OGQ) for enlargement of operations. Also in prospect is the fascinating idea of long-range two-way teletype communication with W6BE, Moraga, Calif. and F8FW (operated by the father of ex-F8JM, and F8FW), St. Mihiel, France, using true f.s.k. on 11 meters.

And so we come up to date in our story of the growth of ham teletype. A nearer-complete roster of active TT network stations in this area should also include W2s HGN, BTP, VGT, ER, TWJ, WHT, PAG, RHN, LRI, SHE, PDX, HUJ, MIB, EIE, OBE, KGP, IRM, IXT, CFT, WIA, NKG, VDM, DXK and HBA. We now have a sufficient number of stations in operation so that the Brooklyn AEC Net is considering arrangements for adding our facilities to that smooth-working organization. Also in the offing is the establishment of a regular traffic-handling net, to be run without the benefit of schedules thanks to our newly-perfected automatic starter unit!

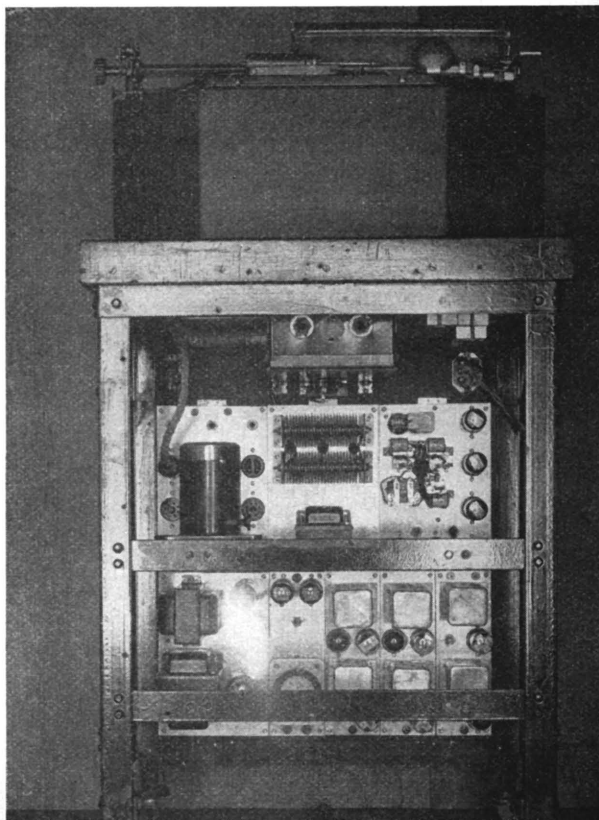
A. F. S. K. Teletype-Station Operation

Fig. 1 shows in block form a typical v.h.f. teletype station. Despite the presence of the mechanical printer, it will be apparent that the system is mainly radio as we know it. Most of our net stations use the now-famous surplus SCR-522 for transmitter, audio and receiver, without major modification except for the addition of power supplies. Suitable crystals for holding the transmitter and receiver to the network calling fre-

quency of 147.96 Mc. are used. The stability afforded by this low-cost crystal-controlled rig helps to eliminate many of the troubles which might be introduced by frequency drift.

To transmit, the frequency-shift audio oscillator is teleprinter-code-keyed by the teletype keyboard mechanism, in turn feeding the various combinations of mark and space tones into the speech-equipment front end and then, as usual, the final and antenna come into play. For receiving, the audio output of the station receiver — teleprinter-coded a.f.s.k. — is fed in common to the space amplifier and detector and the mark amplifier and detector, where it is amplified, passed by either of two LC selective filters, rectified, and the outputs fed, in opposition, to the d.c. amplifier for amplification of the voltage for controlling the action and direction of the polar relay. This latter device, which is furnished with the teleprinter, energizes the machine's printing mechanism.

The automatic clock unit and the automatic starter unit, while optional, are ingenious devices which make possible the reception of a message on an unattended teletype, thereby increasing station efficiency. The a.c.u. is an inexpensive electric-clock motor fitted with a pair of contacts which turn on the station receiver and the a.f.s.k. panel for the first minute of each hour. If no "start" signal is received by the a.s.u. during this period, the receiver and a.f.s.k. panel are shut off again automatically. However, if a starting signal is received from a calling station, the printer



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A peek behind the W2BFD teletype discloses that the a.f.s.k. panel isn't as complicated as the system diagram of Fig. 1 would have it. *Top row, l. to r.:* polar-relay (comes with printer) chassis, selenium-rectifier power supply (for printer magnet voltage), automatic-starter-unit chassis. *Bottom row:* 300-volt plate and heater-voltage supply, d.c. amplifier and balancing meter, mark amplifier and detector, space amplifier and detector, frequency-shift audio oscillator. The leg spacing of the machine allows the use of a standard 19-inch panel.

motors start up automatically and the a.c.u. loses control until the calling station transmits a "stop" signal. These devices are, of course, amply protected by overload and safety devices.

In the interests of standardization, net members have worked out agreement on a number of points. Besides deciding on a common calling and working frequency of 147.96 Mc., we have adopted standard mark and space frequencies of 2125 and 2975 cycles, respectively. This permits the tuning-in of most commercial circuits for test, as well as for diversion. We are also agreed on the use of similar a.s.u. "start" and "stop" signals, on standard printer-table connections so that units can be changed conveniently during emergency, and on rudimentary Q-code abbreviations which are gradually being tailored to our needs.

Several blueprints, the generously-contributed handiwork of Andre Thieblemont, ex-F8JM, are available to interested amateurs for the cost of reproduction. They include: wiring schematic of the table after it has been altered for radio, 25 cents; schematic diagram of the a.f.s.k. panel, 40 cents; and physical layout of the a.s.u. subpanel, 25 cents.

Procurement of Teleprinters

The Model 12 machines that we have been obtaining for V.H.F. Teletype Society members, which are also available at cost to other interested amateurs who meet certain conditions, including the signing of a waiver, are used but in good working order. By our contract with the two telegraph companies mentioned earlier, we agree to take all machines that become available providing they are working on telegraph wires at the time of purchase. The machines have many new parts, and practically all of them are equipped with brand-new 115-volt 60-cycle GE or Westinghouse syn-

chronous motors. The machines are ready to use as received after a bit of cleaning (telegraph companies take marvelously good care of the moving parts, etc., but do not worry too much about oil, grease and dust accumulation).

The teleprinters consist of:

- a) Steel teletype table wired for keyboard and printing units to plug in.
- b) Keyboard unit containing sending and receiving distributors.
- c) Printing unit which types on standard 8½-inch-wide roll paper.
- d) Polarized relay with jack base into which it plugs.
- e) Cover, which may be one of two types: (1) newspaper-office style, which is really a dust cover and which is easiest to remove, or (2) totally-enclosed "silent" type with sound-absorbing padding, which has a glass window for observation and a slot through which the paper issues.

Until further notice, the machines described above can be procured for amateur use by copying and signing the waiver reproduced below (one for each machine) and mailing to J. E. Williams, % Electronic Device Co., 38-06 61 St., Woodside, L. I., N. Y., together with a check or money order (payable to J. E. Williams³) for fifty-five dollars and instructions as to whether the machine should be crated and shipped (with these charges C.O.D.) or whether it will be picked up here in New York. Purchasers should also specify type of cover desired. Delivery of machines is subject to from one to three weeks' delay, and as there are usually more orders than machines available, total delay may be as great as five weeks.

Waiver

Date.....

The teleprinter which I am purchasing from John Evans Williams is to be utilized at amateur radio station.....

It will be utilized only for amateur communications or amateur experimental work. It is agreed that it will not be used for the gainful interception of commercial traffic or news handling.

It is likewise agreed that this machine will not be resold to other than an amateur radio station operator and then only under the identical proviso such as governs the present sale.

By.....
Licensee of Amateur
Station.....

³ Amateurs may purchase teletypes at cost only through Mr. Williams. For certain permitted types of commercial operation, these same machines are available from the Electronic Device Co. at the full price.



W2WCR, Maspeth, L. I., station of the Amateur V.H.F. Institute of New York (ARRL affiliate), which is equipped both for 'phone and teletype operation. Prexy Charley Brown, W2ER, is at the TT keyboard.



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