How it works

A teleprinter is an extremely complicated piece of machinery, but to understand the basic principles the following explanation should be sufficient. The coding used by radio teletype machines (and incidentally worldwide commercial 'Telex') is the Murray code, also called 'Baudot', and the 'CCITT No 2 International 5-unit Start-Stop Teleprinter Code', The complete code (letters, numerals and operational functions) is shown in **Fig. 2.** The letters of the alphabet are transmitted prefaced by a start pulse and followed by a stop pulse. You will note that there are 32 possible combinations of which 31 are used. The exception is the character containing all spaces. The 32 possible combinations available from the 5 unit code are not sufficient for practical use as there are 26 combinations required for the alphabet alone, leaving insufficient for numerals, let alone punctuation marks. The solution is to use the code twice, that is, to make a given combination print either a letter or a number. Two of the 32 combinations are used as 'shift' signals, the function of which is to operate a mechanical changeover device on the machine and so allow the mechanism to print either letters, or numbers and punctuation only. The shift signals are also known as 'case shift' signals. One 'case' is letter shift and the other 'case' is figure shift. The marks and spaces which transmit the particular letter, numeral or punctuation mark are known as 'elements' and are numbered from 1 to 5 in sequence. A start signal is transmitted at the commencement of each character formation and a stop signal at the end. Teleprinter signals, as far as the amateur is concerned, are generally transmitted and received at speeds of 45.45 or 50 'bauds' (more of that later), although there are exceptions. To keep things as simple as possible, if we consider a speed of 50 bauds, the time taken to transmit a complete character including the start and stop pulses, is 150ms and this is divided up as shown in **Fig. 3.**

Combination numbers		Channels 5	4	3	2	1	Letters
1	–				●	●	A
2	?	●	●			●	B
3	:		●	●		●	C
4	Who are you		●			●	D
5	3					●	E
6			●	●		●	F
7	Optionals	●	●		●		G
8		●		●			H
9	8			●		●	I
10	Bell		●		●	●	J
11	(		●	●	●	●	K
12	)	●			●		L
13	·	●	●	●			M
14	·		●	●			N
15	9	●	●				O
16	0	●		●		●	P
17	1	●		●	●	●	Q
18	4		●		●		R
19	·			●		●	S
20	5	●					T
21	7			●		●	U
22	=	●	●	●		●	V
23	2	●			●	●	W
24	/	●	●	●		●	X
25	6	●		●		●	Y
26	+	●				●	Z
27	Carriage return		●				
28	Line feed				●		
29	Letters	●	●	●	●	●	
30	Figures	●	●		●	●	
31	Space			●			
32	All space						

Feed holes

FIG. 2. The full Teleprinter code

Transmitting a character

When a key of a teleprinter is pressed it causes a moving contact inside the machine to switch between two fixed contacts at a rate and sequence dependent on the telegraph speed. In this case we are thinking of 50 bauds. Machinery inside the teleprinter selects the letter keyed, and operates the transmitting contacts. If a positive voltage is applied to one fixed contact and a negative voltage to the other, as the moving contact changes from one side to the other, a positive or negative voltage appears on it. This voltage, when fed to a audio generator produces the two tones sounding like the 'jingle bells' mentioned above. The two tones used by amateurs today are 1275Hz and 1445Hz. The difference between the two is 170Hz and this is termed the 'shift'. These shifting tones are then applied to the microphone socket of a tranceiver or transmitter and radiated as a signal. The signal contains the start pulse, the 5 elements of the letter and the stop pulse as described earlier. The signal is received by the distant end and decoded in the reverse manner.

Receiving a signal

When the varying tones are received at the distant end, tuned carefully so that both tones have equal amplitude, and applied to that item of equipment that I shall discuss later, the 'demodulator' or 'terminal unit', the circuitry of the TU will change the two tones received over the air into a fluctuating voltage, having the same plus-and-minus variation as the original signal sent out by the transmitter. This varying voltage, when connected to the magnet of the receiving teleprinter (also designed to operate in the 'double current' mode) and which is running at the same speed as the sending teleprinter, will then print the signal which has been sent.

What is this thing called a "baud"?

I talked about two amateur speeds earlier, 45.45 and 50, and I called them 45.45 bauds and 50 bauds. The 'baud' is a term used for the 'signalling speed'. If we talk about a speed of 50 bauds, a character takes 150 milliseconds to send including the start and stop pulses (see **Fig. 3**). The signalling speed is equal to 1000 divided by the time taken to send 1 element of the character (in milliseconds). In the case of 50 bauds, dividing 1000 by 20 = 50 (bauds). Machines operating at 50 bauds generate 7½ units of 20ms length = 150ms. Since a word is defined as having 5 characters plus a character space, a word = 6 x 150ms = 0.90 seconds length. Because there are 60 seconds in a minute, a machine operating at 7½ units 50 bauds can send or receive 60 divided by 0.90 = 66.6 words per minute. The other amateur speed, 45.45 bauds, takes 22ms to send 1 element and when worked out with the same formula gives a speed of 60 words per minute. There is no need to get too concerned about this matter of speed though. There are some quite simple methods of checking the speed of a teleprinter that I shall discuss in a later article.

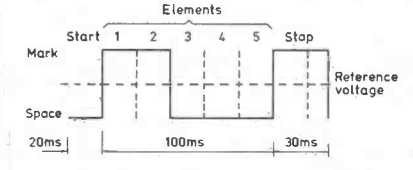

FIG. 3. The letter 'A' a typical character construction