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DEFINITIONS ETC. (1)

Bombe, Diagonal Board, Spider, Turing and
Welchman attachments, shorting plugs,
Hand Bombe, Cut Out Wheels, Requirements.

TERMINOLOGY.

By a "Bombe" we mean a mechanically driven synchronised set of enigmas. Originally the enigmas of a Bombe were connected in series, but the Bombe becomes a "Spider" when the inputs and outputs of the enigmas are connected to the rows of a "Diagonal Board". A diagonal board consists of 26 rows of terminals, the rows corresponding to the letters A, B, C,.....,Z. We shall refer to the rows as row A, row B, etc. Each row consists of 26 Terminals corresponding to the letters of the alphabet, and we shall use small letters a, b, c,.... to denote the terminals of a row. Thus Xv is the terminal in row X which corresponds to the letter v, and Xv is connected to Vx by the permanent wiring of the diagonal board. Both Xv and Vx correspond to the "Stecker" X/V.

THE SPIDER. Turing Attachment.

The action of a Spider is controlled by a "Turing Attachment", which works as follows :- If the input is at Pa, (i.e. at a point directly connected to the Pa terminal on the diagonal board), the Spider stops whenever the remaining 25 terminals Pb, Pc, ...Pz of row P are not all energised. When all these 25 terminals are energised, the Spider carries on.

When the Spider stops only two cases are likely to arise.

(1) No one of the 25 terminals Pb, Pc, ...Pz is energised, when P/A is a story.
(2) All but one, say Py, are energised, when P/Y is a story.

WELCHMAN ATTACHMENT. Hand Bombe.

This attachment, consisting of a diagonal board and a "Machine Gun", is intended to test the stories produced by the Spider. The diagonal board connections are the same as for the Spider, but the input may have to be altered and the enigmas must be wheeled to the correct position and must be stationary for the test. In case (1) above the input would be at Pa, while in case (2) it would be at Py. A story is thrown out by the Machine Gun if more than one terminal is energised in any one of the 26 rows of the diagonal board. When a story survives the machine gun, the actual terminals which are energised are shown on a lamp board.

It will appear later that the time taken by each stop makes it most undesirable to use this attachment with a high speed Bombe. It should be used with a "Hand Bombe", consisting of about 15 enigmas which are synchronised, as in the Bombe, but hand operated. Each row of wheels must be wheeled independently, so that the input enigma can be quickly turned to any desired position. Switches are necessary to make the input at any specified letter.

The Hand Bombe would also be used instead of a set of hand enigmas, in conjunction with our existing set of lamp boards.

SHORTING PLUGS.

For certain particular jobs, both on the Spider and on the Hand Bombe, it may be necessary to common up a number of terminals on the diagonal board which are not permanently connected. The requirements will vary considerably, but the following examples should give an idea of the sort of problem that may arise.

(1) The terminals to be commoned up are Ba, Bc, Bd,.....Bz, in fact all terminals in row B except Bb.

(2) The terminals to be commoned up are Ba and Bc, Cb and Cd,...Yx and Yz.

(3) The terminals to be commoned up are
Ab, Ac, Af, Ah, Ap, Ar, Ay,
Ba, Bd, Bg, Bi, Bq, Br,
Ca, Cf, Cj, Cl, Cp, Cq, Ct, Cx,
.....
.....
Zc, Zf, Zj, Zo, Zr, Zu, Zw.

These problems can be dealt with very simply by shorting plugs. Each shorting plug is an alphabet jack which can be quickly adjusted to common up a particular set of letter terminals, for a particular job. The shorting plugs should fit into the rows of the diagonal, board without interfering with the plugging of the leads from the enigmas.
To deal with job (1) a shorting plug is adjusted to common up all letters except b, and is plugged into row B of the diagonal board. For job (2) 24 shorting plugs are required; the first commons up a and c and goes into row B, the second commons up b and d and goes into row C , and so on. Job (3) requires 26 shorting plugs; the first commons up b, c, f, h, p, r, y, and goes into row A, the second commons up a, d, g, i, q, r and goes into row B, and so on. As there are three diagonal boards on our spider, job (1) requires three shorting plugs while job (3) requires 78.

It is clear from the above that the shorting plugs must be quick to adjust, so that they must not interfere with the plugging up of the leads from the enigmas, and that they should not be fixed onto these leads, except possibly by a clip. We urgently need half a dozen such plugs, and should like the rest as soon as possible, but we had better experiment with the half dozen before more are made. Job (1) is far the most important type at the moment.

CUT OUT WHEELS.

Another scheme which would sometimes be of great value is as follows :- For a particular problem we may only be interested in a limited number of positions of the enigmas and the time spent by the Spider in testing other positions is wasted. For instance we may only want to test positions in which the slow, medium and fast

wheels of the input enigma are in the positions C to F, M to X, and K to Q. It should be possible, by means of "Cut Out Wheels" to ensure that the Spider will only stop at positions in this range..

NATURE OF PROBLEMS.

It must be clearly understood that the jobs contemplated by Welchman's party are very different from those put on by Turing's party. Turing always runs a full range of wheel orders and only allows the Spider to stop a few times in each run; he only needs the Spider as it is now. Welchman on the other hand can often reduce the number of wheel orders and the range to be tested in each wheel order. Welchman will also have other evidence which can be used by means of Shorting Plugs and Cut Out wheels. The vital factors from Welchman's point of view are the time taken by each stop of the Spider and the time taken to test each story. The necessity for wheeling to the correct position each time the Spider stops is most serious. As soon as the correct position can be automatically recorded Welchman will be able to put on jobs involving up to 100 stops per wheel order. When the Hand Bombe is available, an even larger number of stops would be possible. If Cut Out Wheels can be designed it will be possible to run jobs which would give a thousand stops if taken over the full range.

This desire to put on jobs which involve a large number of stops is not a mere whim. In any problem we use all the data we possess to reduce the number of stops. The object of the various improvements suggested is to enable us to make full use of all our data, so that we can solve problems even when our data are very scanty. We are driven to contemplate a large number of stops in certain cases, and the power of the machines really depends on the rate at which stops can be recorded and tested as well as on the methods for making use of additional data, such as Shorting Plugs and Cut Out Wheels.

REQUIREMENTS.

(1) Immediate supply of adequate Shorting Plugs.

(2) Immediate attachment to B.P. Spider of lamps which will show the position of a stop and the letter involved.

(3) Supply of Cut Out Wheels.

(4) Design of a Hand Bombe.

(5) Improvement of the automatic recording of the stops of the Spider, allowing for more than one stop in a revolution of the unit wheel. The possibility of a stop involving more than one letter must also be considered.
