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by

[illegible]

(C) [illegible] modifications, the chief of which are [illegible] coupling from the [illegible] detector, use of negative intensity modulation on [illegible] and use of a long [illegible] screen have been [illegible] on Gebo [illegible] receivers [illegible]. The performance of the modified circuits was compared with [illegible] Gebo receiver.

It was found that the modifications render the system non-linear and it [illegible] not be used for height-finding. The frequency response of the [illegible] modified chain is rather slightly worse.

With [illegible] interference the normal receiver is better than the modified [illegible] to the [illegible] of the series limiter. With railing interference the modifications constitute a definite improvement for Gebo working.

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1. Introduction

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The modifications have been in service use at a Gebo station (Ingate) for some time; these tests were undertaken to obtain a precise measure of its effectiveness, and also to ascertain whether it could be used for height finding. Linearity tests were made, response curves taken, and the performance under various conditions of interference compared with that of the normal receiver.

[illegible] Modified Circuits

The modifications introduced by Mr. Brownless consist of:-

(a) D.C. Coupling from 2nd detector to first video valve, and a series limiter.

(b) Facility of positive or negative intensity modulation on H.R. display.

(c) Use of [illegible] tube with long-afterglow screen, together with a colour filter to facilitate viewing; this allows only the afterglow to be seen and so cuts out much of the interference which otherwise forms a confused and shifting picture lighting up the greater part of the tube.

(d) [illegible] speed time-base. An alternative time-base 30 miles long can be switched on the [illegible] display.

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[illegible] to the negative intensity modulation which brightens up the [illegible] a signal deflection less visible as such, though it can be [illegible] as a dark "hole" in the time base. Negative intensity modulation [illegible] in all the tests. For a narrow signal the faster time base [illegible] a hole in [illegible] out that hole and making it more visible. When interference is present, this hole can still be seen and gives sufficient indication for [illegible].

2. Linearity tests

Linearity tests were carried out at 205 Mc/s. using a pulsed signal generator. The gain control was set to give 5 cms. deflection for a signal of 60 db below 0.1 volt. The number of db by which it would be necessary to turn down the input signal to give a deflection of 4½, 4, 3½ cms. etc. was calculated on a basis of strict linearity. The attenuator of the signal generator was then successively turned down by these amounts and the actual deflection on the R.F. tube measured. Between each measurement the attenuator was returned to 60 db below 0.1 volt to ensure that the deflection was still 5 cms. and no drift (as of [illegible] voltage) had occurred. If the circuits are linear the observed and calculated deflections will be exactly equal; the specification allows of a deviation in the observed deflection of ± 0.2 cms. from that calculated.

The curve taken for the normal receiver (Figure 5) shows a maximum deviation of 0.3 cms. That for the modified circuits shows deviations amounting to well over 1 cm. Similar results were obtained using a stronger signal and a lower setting of the gain control.

The modified circuits are, therefore, non-linear.

3. Frequency response of signal chain

The modifications involve changes on the signal chain in both calibrator and indicating units. The changes made to the output valves on the indicating unit are such as slightly to improve the frequency response. The response is 3 db down at 1.1 Mc/s. instead of 0.95 Mc/s. as in the normal receiver.

The response of the video signal chain in both normal and modified circuits is limited however by the [illegible] stage on the calibrator panel. Figure II shows curves of the overall response from calibrator panel input to R.F. tube. The response of the normal circuits is 3 db down at 360 kc/s.; that of the modified circuits at 270 kc/s.

The frequency response is made slightly worse by the modifications.

4. Interference tests

For these tests two R.F. racks were set up side by side, the one with normal circuits and the other with modified circuits. Both calibrator units were fed from one R.F. and I.F. panel, so ensuring that both systems had exactly the same interference conditions at any time. Various types of interference were put on, and the range of signal strengths that gave a visible indication on the R.F. tube measured.

The signal limiters were set so as just to limit a pulse that gave a deflection of 7 - 8 cms. All tests were carried out at 205 Mc/s., and the signal/noise ratio was 2/1 at 80.5 db down on 0.1 volt.

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4.1. C.W.

Gain control at 10

Strength of C.W. at normal socket	D.C. Volts on detector	Range of signals visible in normal	Range of signals visible in modified
9[illegible] db below 0.1 volt	10 volts	91-0 db below 0.1 volt	97-0 db
85 " " " "	16 "	83-0 " " " "	93-0 "
75 " " " "	28 "	78-0 " " " "	72-0 "
65 " " " "	38 "	70-0 " " " "	64-0 "
55 " " " "	49 "	58-0 " " " "	54-0 "
45 " " " "	54 "	45-0 " " " "	43-0 "
35 " " " "	58 "	33-0 " " " "	30-0 "

With C.W. of 35 db down maximum deflection on H.R. tube is with the gain set at 7. The range of signals visible in both normal and modified circuits is then about 43-0 db.

With C.W. of 35 db down changing the limiter from its normal setting will enable signals down to 38 db to be seen in the modified circuits.

4.2. M.C.W.

Modulation frequency about 5,000 cps.

Modulation depth about 80%

Gain set at 9

Peak strength of M.C.W.	Range of signals visible in normal	Range of signals visible in modified
68 db below 0.1 volt	81-0 db. hole in time-base	77-0 db. hole in time-base
55 " " " "	85-0 " " " " " afterglow screen and colour filter facilitates observation.	74-0 " " " " "
28 " " " "	76-67 db deflection visible 70-0 db - only visible with afterglow screen and filter.	75-0 " " " " "
7 " " " "	70-57 db deflection visible 70-0 db - only visible with afterglow screen and filter	70-0 " " " " "

In normal working, with positive intensity modulation, the time-base trace is very faint, and a hole can only be made out with afterglow screen and filter. It is not possible to see the deflection due to a signal except for weak signals the tops of which are visible, since M.C.W. of 5,000 cps. gives nearly vertical lines on the picture, and among these a vertical deflection cannot be distinguished.

In the normal circuits the range over which a signal is visible can be extended by turning the gain down.

Thus with M.C.W. of 7 db down, gain 10, signal deflection visible 70-57
" 2 " " " 30-0.

/4.3.

[illegible] railings have equal on/off ratio

Gain at 10.

[illegible]	Railing width	Range of signals visible in Normal	Modified
[illegible] db down	35 μ sec.	83-0 db down on 0.1 volt	83-0 db down on 0.1 volt
	23 "	79-0 " " " " "	81-0 " " " " "
	14 "	76-0 " " " " "	7[illegible] " " " " "
	7 "	72-0 " " " " "	65-0 " " " " "
[illegible] db down	35 μ sec.	79-0 " " " " "	83-0 " " " " "
	23 "	60-0 " " " " "	53-0 " " " " "
	14 "	72-0 " " " " "	55-0 " " " " "
	7 "	60-0 " " " " "	55-0 " " " " "
3 db down	35 μ sec.	72-0 " " " " "	81-0 " " " " "
	23 "	59-0 " " " " "	54-0 " " " " "
	14 "	65-0 " " " " "	54-0 " " " " "
	7 "	59-0 " " " " "	45-0 " " " " "

[illegible] poorer figures for the modified circuits are probably a result of the [illegible] limiting brought about by the series limiter; on the screen this results [illegible] line losing its brightness, so that it is no longer easy to notice a [illegible] in it. The presence of some C[illegible] with the railings may have added to this effect.

Change of gain control or limiter setting gave very little improvement.

[illegible] Amplitude modulated railings Gain set at 10.

Modulation frequency and depth	Railing width	Strength	Range of signals visible in Normal	Modified
5,000 c/s. appears about 40% modulated at detector	15 μ sec.	35 db.	84-0 db	84-0 db
		0 db.	78-0 "	84-0 "
	9 μ sec.	35 db.	81-0 "	83-0 "
		0 db.	78-0 "	82-0 "
50 c/s. Depth of modulation very low: almost pure railings	9 μ sec.	0 db.	67-0 "	79-0 "

[illegible] Two sets of railings :

			Range of signals visible in Normal	Modified
Alone	Railing width 23 μ sec. equal on-off ratio strength 35 db down	AND Squegging railings 15 μ sec. long. Strength 0 db down. Low % modulation at 5,000 c/s.	72-0 db	81-0 db
[illegible]	As above	As above 9 μ sec. wide	72-0 db.	81-0 db

/5.

[illegible] Conclusions

[illegible]ght-finding. Straight-finding is impossible for three reasons:-

1. [illegible] system is non-linear.

2. The modifications do not "clear up" the picture. When interference is on, it usually renders the outline of the signal indistinguishable.

3. With negative intensity modulation the tip of a signal deflection is not sufficiently clear in some cases for its length to be seen.

The frequency response of the signal frequency amplifier chain is 3 db down at 310 c/s. in the normal receiver, and at 270 c/s. in the modified receiver. For a given strength of C.W. interference the weakest signal visible through the modified circuits is always a few db stronger compared with the weakest visible on a normal receiver. This is presumably due to the more efficient limiting action of the series than the (normal) parallel limiter.

For all forms of pulsed interference, i.e. railings, the modifications are a definite help and enable signals to be seen when they are invisible on the normal receiver.

Of the various modifications in the Brownless circuits, D.C. coupling certainly seems to be a help against railing interference. For C.W.I. working negative intensity modulation and the long afterglow screen with colour filter are a help in reading signals; this last is in some cases useful when fitted to an otherwise normal receiver.

7th July, 1943.

(No. 8-)

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