[[NB07-001]]

8 x 32	256
16 x 32	512
24 x 32	768
30 x 32	906
32 x 32	1024

25-5-51

Experiments on 8 way mixer using KT61s.

0 61

2 1 57

~~39~~
62 3
33
30
4 5 6 7
48 ~~59~~ 31
~~65~~ 39

	I Anode	Is		
0	-	-	-	-
1	-	-	-	-
2	~~0.2~~	~~0.04~~	.9	.2
3	~~0.23~~	~~0.07~~	1.0	.4
4	~~0.15~~	~~0.02~~	0.1	.~~4~~ 1
5	~~0.14~~	~~0.01~~	.6	.1
6	~~0.05~~	-	.3	-
7	~~0.33~~	~~0.05~~	1.2	.3
	~~1.1~~	~~0.19~~	4 7	1.1

Total 5.2 mA

[[NB07-002]]

with 100K in common screen bypassed to earth thro .5μF current ratios similar.

Capacitive Coupling

[[DIAGRAM - CIRCUIT]]

with C = .001 R = 2K2
with 8 KT61 coupled as above output only few volts due to low [[time]] constant

with 12K2 in all cathodes and ~~connecting~~ inserting three valves only but with .5μF coupling on cathode of valve to which pulses were applied.

	Input	Output
Digit pulse	24v	19v
Clock Pulses	29v	7v

With common cathode of 2K2 but with separate screen dropping resistances in each valve of 100K decoupled .5μF on input valve only
~~Clock Pulses~~
4 valves in circuits

clock Pulse	29	27

8 valves in circuits (No 61.)		29	25
Digit Pulse		23	21

[[NB07-003]]

	Ia	
61	.1	
57	.6	
62	.7	
33	.6	
48	.4	
30	.8	
5	.2	
31	.9	.2

		In	Out
31	Digit Pulse	23	21
	Clock Pulse	29	24

Ac Coupling to grid reduces output to 18v for clock

61	Digit	23	15
	Clock	29	17
31			
	Clock	29	18.

[[NB07-004]]

[[DIAGRAM - CIRCUIT]]

7 5
18
10.5
4
135 9.5
5
4½
13
4.5

[[DIAGRAM - CIRCUIT]]

One valve 2K2 cathode load 20 input - cathode 11 volts
Two valves common load - 12.5 -

Valves in	31 only			
			Input	Out
	31 only	9.5	10.5	9.5
	*31 + 62 in	9.5	10.5	8.5

	*31 + 61	9.5	10.5	8.5
	x62 31	9.0	10.5	8.0
	x62 & all others	8.5	10.5	7.0
	x31 " " "	9.0	10.5	7.0
	62 only	9.5		
1	62 & all		16	12
	31 & all		16	12.5

[[NB07-005]]
Amplifier Micand SU.
Micand to CCU II
Acc IO Tidy
Acc Shifting Units pending Attr Tests
CCU II Tidy
CCU IX
CCU VI
CCU V
PAD

31-5-51

Since the last demonstration Chaos has reigned. Leo is very unoperational. We have now got seven new racks grouted in and the electricians are at work providing power and bonding. This morning the ducting engineers are coming to connect up the ventilation system and then the carpenters will restore order by fixing the floor. Gibbs has been working on the Control Desk but although lights light up and relays click at appropriate moments we shall not know how much of it works until I get some

[[NB07-006]]
of my wires back into position. I have had to disconnect so many leads that it will be a major task to restore order again.
Only one large modification has been attempted during this shutdown and this has been the transfer unit which has been rearranged so that the 1 pulse [[internal delay]] and the amplification and clocking happens after the delay in the transfer tanks.
Provision has also been made for entries to & from the Annex [[tabes]]

Consideration has been given to requirements for the new coder which provide Order waveforms for HS1 and HS0 also for slow speed changeover.
~~Incidentally~~ Also on the same chassis is being put the ~~new~~ extra rack decoding arrangement for the double length store.
(Incidentally this seems rather a short sigthed policy in view of the fact that if more actions are enviseaged eg Division A.T. Clear etc. there will be little room for the extra mixing etc of the new coder waveforms.)
The wiring to this new Coder presents a problem. Its

[[NB07-007]]
natural position is adjacent to Coder I but this calls for a major upheaval on the Action decoding rack. If it is put at the bottom of the rack it means that the Coincidences Waveform on its way to the tank decoders must make a long detour

before it reaches its destination. The extra decoding for the double length store
Later
Is has been agreed that the rewiring problem shall be resolved as follows :-
The new coder shall take its logical position ie just below Coder I. As this involves a

major wiring change it will be installed temporarily at the bottom of the rack leaving one space between it and the lowest unit.
The rewiring will then take place piecemeal as one unit at a time is shifted down one place. When the vacant position is made next to Coder I Coder II will be installed and the wiring can be completed in its permanent form. In this way the change should be made in odd periods without interfering with the working of the machine.

[[NB07-008]]

11-6-51

Just returning to work after a weeks holiday at Clacton.
Before I left Leo it was almost working with some evidence of corruption ~~it~~ in the modified transfer unit due to one of the mixing circuits.
Most of the Control Desk wiring is complete but without the monitor scopes it is difficult to use this and many of the control lines have had to be duplicated.

Later
Leo has been working with sundry faults here and there but today very little would work at all. Spent most of the day with Shaw trying to sort things out. Two faults were obviously due to setting up -
(a) Insufficient amplificating of Micand to trigger off [[mication]]
(b) New DC flip flop not working due to intermittent contact between two uninitiated R's
Late this evening another trouble was eliminated This also was due to a new modification this time in operating control.

[[NB07-009]]
This last fault has not entirely been eliminated but only bypassed by preventing a relay from operating.

With the approaching day when Leo goes over to useful production I must gather together my ideas on fault finding for it is becoming increasingly obvious that the success of the project depends largely on the quick diagnosis & cure of faults
So far, the test programmes fail completely as soon as there is a fundamental fault

which is not serious enough to show up on a simple manual programme and yet prevents the normal test programmes ~~from proving~~ being taken in.
A case in point is todays experience of being unable to detect a fault on the Add order as a simple programme while when taking in a tape the intial orders fail on Add.
If some means could be found of doing successively a number of preselected orders on operating on a few selected numbers with an indication of failure this would fill a long [[felt]] want.

[[NB07-010]]

Possibly a plug board would be the answer

[[DIAGRAM]]
A S G E T U V H C X Y R L a b d d

This would call for decoders to select each of the orders selected in turn
An alternative method would be to have a simplified Initial Input programme for taking in tape specially prepared. This idea was developed in these notes some time ago.

13-6-51

During my holiday the following changes have been made.
1. Final Racks Grouted in & powered.
2. False floor completed
3. Smart & Brown Lathe & Melting machines delivered but not installed (benches being made by Joinery.
4. Mod to Transfer Unit
5. " " CCU II
6. " " Op Control II

[[NB07-011]]

13-6-51

More troubles have been traced today but we are not yet out of the wood. [[One of the]] more difficult faults to trace was an occassional failure of w[[13]] to reset, leaving the order still in the Order Tank.
The fact that the PAD flip flop was reset was taken to ~~ge~~ mean that the W13 flip flop was insensitive to reset but later it was discovered that the PAD was not being set at all ~~causing~~ so that the order was never carried out
This was found to be due to breakthro of W15 on the S_R' pulse which sets PAD

this in turn was traced to a faulty diode in panel 12. I had noticed some time ago that there was rather a lot of breakthro on the S_q' pulse but as it was not excessive & had not caused trouble I had let it slide. Now however the trouble was much worse although there was not much to show on the valve tester that the particular 6D2 was any worse than others.
With this corrected Leo lapped up all the test programmes but failed on the Dem Payroll.

[[NB07-012]]
The cause of this was found to be corruption of constants in the conversion 240000, 24000, 2400 and 240 being OK but 120 12 10 & 1 being reproduced as 20, 2, 0, and 0.
This was rather difficult to explain as if the machine was lead slowly over these conversions it did them correctly and went on to do the whole payroll without a hitch.
A tape has been produced which repeats 120 120 120 in the required positive and this should enable

us to investigate further.

. 14-6-51

Fault on multiplication was the cause of most of my trouble. This in turn as far as can be seen is due to the mod which has been made on CCU II In multiplication the R_2 pulse is inhibited by W8- to prevent an add end pulse (used when micand is zero) It was found that the new W8- was getting down a little more smartly than before and the back edge of the R_2 pulse was getting thro to set up conditions for an add End pulse

[[NB07-013]]
By delaying W8- by 1μS the trouble is overcome.
Another trouble on a multiplicant has been found meanwhile. This occurs when D35 is squared. The flip flop in the complementer is incapable of being set and reset by adjacent pulses as this multiplication require.
In view of the fact that the complementer is due to have its Flip Flop converted to a DC type I have not pursued this farther than establishing that $D34^2$ is carried out correctly.
I have developed further the idea of an simpler method initial input sequence involving

only I A T & L orders. It seems that it would be a comparatively simple matter to arrange this.
In writing a note on this it occurs to me that it would possibly be an advantage to have all programmes taken in in this way, although the present method of making up the address of orders presents a bit of a problem.

[[NB07-014]]

15-6-51.

Leo now fully operational. Some tests concerning the new P programme have been made satisfactorily and I now have a day or two respite in which to clean up some modification.
One thing that has been done in preparation for this is the temporary hook up of Coder II which will enable Shaw to get his Coder Waveforms for HS input & output.
A snag arising [[out]] of this is that C27- which is delayed [[as]] the Coord will have to have the delay shifted to the Coder as this unit provides

a high [[instance of low]] impedance output and the present input to the Coordinator is the straight entry into the delay line.

18-6-51

Spent best part of today modifying Transfer Unit to give amplification of pulses ex Store. Managed to get thro the test OK afterwards but the setting of this amplifier is quite critical. Hemy has some test programmes to try out tomorrow but when I am clear of these I must do some further tests on Transfer Unit. During the shutdown I got [[Wheeler]] to power up the two extra

[[NB07-015]]
storage racks so that the store can be effectively doubled when required.
The job which is being prepared for Leo is Bakery Sales Valuation and it will be done in three parts - presumably because the present capacity of the machine is too limited in any case any one of the parts will call for 30 tanks of store.
The Raster scope is temporarily out of commision being modified by Shaw for use with the Annex this means that the investigation of any faults on the programme

that Hemy tries will be rather tiresome.

19-6-51

A rather unsuccessful day on the whole. After spending so much time yesterday evening getting things just so. Leo refused to work at all this morning. Fortunately it did not take long to find the trouble - a blown fuse in the Acc Wiring unit which provides ~~that~~ the Acc Clearing waveform.
This is the second time to my knowledge that this unit has blown a fuse ~~un~~ [[unaccountably]]. JMMP has agreed that all units shall

[[NB07-016]]
be modified so that the neons light up when the fuse blows.

[[DIAGRAM - CIRCUIT]]
load
After this Hemy tried out two of this test programs one of which worked correctly first time but the second ~~of~~ failed. He is convinced that the machine has failed him
It certainly went very wrong after this during a demonstration to Mr - & a friend brought round by Mr Thompson.

As I had been modifying the transfer unit I directed my efforts to improving the amplification of nos ex store. ~~I~~ Everything pointed to this type of fault until I noticed that the intial orders were being corrupted occasionally.
By putting in patterns in consecutive position of the store it became apparent that the trouble was in tank 0
I was not able to find the source of the trouble and if it is not immediately apparent tomorrow morning

[[NB07-017]]
I will change the panel 1.
Once again a lot of ~~trouble~~ time was wasted due to not getting a definite pointer on the trouble to start with.
If I had had my new simplified initial orders available these would not have assisted me as the trouble occurred in the very store position in which the intial orders were stored.
This suggests that one of the first tests that should be tried is the storing of different patterns in tank 0 & 1. This can be done

easily enough by means of the number simulator and the single pulse generator.
20

[[NB07-018]]

20-6-51

The trouble in Tank 1 did not repeat itself today and so I have had to leave that trouble until it reccurs.
There was still lots of other things to deal with however and progress has been made.
The main fault was the inability to print ~~tin~~ intelligence. Normally a fault of this kind would have been diagnosed as teleprinter or output unit immediately, but being in the middle of a

Transfer Unit Modification it was assumed to be corruption of pulses in the transfer unit. Certainly all is not well here and some further mods have been made. Eventually investigations lead me round to the output circuits and after a lot of sweat it was found that a cam operated contact on the teleprinter had worked loose so that the T contact was [[breaking]] much too late.
After this it was about an hours job to get at the offending ~~job~~ part and put it right

[[NB07-019]]
After this all test tapes were done correctly and Hemy put some more of his test routines thro for the new Bakery Sales job.
The failure of two of these is thought to be a programme fault.
Talking over the transfer unit problem with JMMP we have arrived at the conclusion that the solution may be Anode follower amplifiers in place of the cathode coupled amplifier. It will be possible to use the virtual earth of this inpue amplifier as

a mixing point thus saving valves as well as providing pentode amplifiers

[[DIAGRAM - HORIZONTAL]]

Store
Store
Computer
Input

Annex
Transfer

Transfer Tank
Order Tank
Annex

Store
Store
Output
Computer

[[NB07-020]]

21-6-51

More Teleprinter trouble this morning which wasted best part of the morning.
The afternoon was spent trying to produce an amplifier which will serve its purpose in the transfer unit.
So far the Anode follower & See Saw circuits have not been found very succesful as they both take about .5μS to get up thus producing more phase delay than we can tolerate.
JMMP is [[considering]] some sort of [[limiting]] circuits.

Suppose the pulses [[for]] amplification were applied at the cathode of the amplifying valve.

[[DIAGRAM - CIRCUIT]]

This then becomes nothing more than the second half of the cathode Coupled Amplifier.
It seems that this type of amplifier which can be made to limit by a small input pulse is after all the best thing that can be used in this position.

[[NB07-021]]

[[DIAGRAM - CIRCUIT]]

something could be saved by alternating the first valve of the cathode follower amplifier and using the output valves on the Junction units as the mixers. This would require either a ~~fixed~~ variable voltage on each junction unit ~~or else the~~ to set individual gains or ~~more~~ preferably a single variable voltage on the Transfer Unit with the cathode taken to a voltage some 20v below earth

This would enable all the mixing valves to have their grids returned to the same potential (earth) and the gain setting of all the store inputs to be set by a single control. This may mean that all the output valves of the Junction units may need to be ~~restored to~~ changed to SP 61.
But first it would be as well to see if such an arrangement would in fact give a [[saturated]] output

[[NB07-022]]

25-6-51

The amplifier mentioned earlier has been tried and so far found satisfactory. I have built it into the Transfer Unit but it remains to be seen whether it will be possible to mix & store outputs as easily as two.
Tests on Bakery Valuation programme proceed apace and many of the programmes worked first time.
Have tried out my new initial orders programme I punched a tape from one of the old test programmes used in the days before input and output, and put the initial orders in by hand. It worked first time! and now I must find a means of putting these orders on a switch.
I still feel that it would be possible to arrange for readdressing routines using this programme
Fundamentally all this means is that the suffix character would have to direct control to a different set of orders when a G K order met. I must consider this at some more appropriate time
One obvious fact arising

[[NB07-023]]
from this test is that a much quicker intake of tape is possible when the normal [[synthesising]] arrangement are bypassed.

A policy decision is needed at this stage to direct my next efforts.
So many of the recent programmes have been unrealistic in that they did not allow for time between mods to recover and render the machine serviceable again and to allow programmers to do tests on their routines.
Now it seems necessary to

discriminate between
(a) Necessary changes to make the machine function reliably and cover needs for increased capacity, and
(b) Refinements designed to allow a wider safety margin and provide more automatic operation at starting.

The former obviously should take priority although there may be some items that at present come under (b) which may due to change in component valves etc require to be classified under (b)

[[NB07-024]]
Items under (a)
1. Double Store Capacity
2. Complete check on Transfer Unit
3. Install second tape reader

Items under (b)
1. Complementer
2. Z order
3. Stage II (bogus)
4. Shifting Units
5. Control Desk circuits
6.

[[NB07-025]]

27-6-51

Fairly successful day on test programmes with one or two "relics" cleared out of the way.
Part of the Bakery Valuation programme has been developed to such a stage that actual data was used to produce results which have not been checked yet against the office results.
This morning I rather hoped that I had satisfactorily cleared the Transfer Unit [[plod]], but late this evening I was having trouble again and on investigation

I find that the 18 volt pulses are now about 9 volts. If the input from the store is taken to earth thro a 3K3 resistance however, this brings up the pulse to correct size
One explanation could be that the cathode load of the input valve had gone high thus restricting the current passing thro the valve.
I have started increasing the capacity of the store. The first stage is to complete the first two racks ie 16 tanks This has already been done and after rejecting two units

[[NB07-026]]
I now have a new [[store]] tests 5/9/16 ' which works satisfactorily
The next step will be to bring in the next racks ie 24 tanks and then to 30 tanks - two being still out of use one for Frequency control and the other ~~for~~ being the faulty tank
I feel I must insist on being left to myself for this extension instead of having to suffer so many interruptions

2 July 1951

This extension to the Store seems to have landed me in trouble. As previously reported the first step of increasing the capacity of the store to the Tanks (512 compartments) seems to work OK and an intermediate stage was reached at which 24 tanks (768 compartments) worked
But on trying out 30 tanks a series of snags cropped up which have not yet been solved.

At first I thought that the trouble might well be that as the store tests I was using were stacking the programmes in an untried

[[NB07-027]]
part of the store occassional faults in the programme itself were likely to cause failure.
In order to overcome this I asked Fantl to concoct a new programme which stacked the orders in an early tank.
This too failed however and on trying an ordinary SS test on 14 tanks I found that corruptions were being made in the intial orders.
So this morning I must go back to simple tests again.
We are hoping to extend our staff in the near future. First of all Miss Cox has

left us - to our regret.
Second We are expecting a vacation student to start shortly who will work on tank and frequency monitor.
3. [[Turners]] now is keen to get experience in electronic workshop
4 We are interviewing instrument makers for one who can take over small mechanical work
5. We have interviewd some [[wuenent]] for junior position under Dutton

[[NB07-028]]
After some work on the store which produced rather negative results, Caminer asked for some tests on programme routines. These Took the whole of the afternoon and in no case was the machine at fault.
Fantl has produced the S_g store test in a shape that will eneable it to be used for any size store.

5 July 1951
Last two days have been spent on the new battery which is now working but not necessarily completely satisfactorily.
Much of the trouble in getting satisfactory circulations in some of the new tanks was lack of a termination on the input line on Rack 3.
With this dealt with one tank remained in which I could get no circulation at all. By measuing resistance to earth of the coax plug contacts I found that There was a short to earth from the coil at one end of the battery. On removing the

[[NB07-029]]
can I found this to be due to the tag on an insulating pillar shorting to the side of the can.
With this cured a new store test S4/30 tested and found satisfactory all tanks connected up.
An inspection of the unclocked pulses however shows that some of these tanks have quite serious phase shifts and I think it will be quite remarkable if we are able to use them reliably
Fredericks the vacation student has started and is working on the third battery.
JMMP wants him to do some research into delay lines using

a very wide band receiver and a very short pulse so that the reasons for widening of pulses can be explained.

I have thought a little more about simplified initial orders and find that by putting the Discriminant first on the tape, I can cut the sequence down to 24 orders including two clearing orders not previously included.

[[NB07-030]]

9-7-51

A programme using 947 compartments out of the available 960 was tried on Friday afternoon.
It took 5 minutes to take in the programme and then proceeded to comsume the data and print cryptic figures for about 10 more minutes
The results were not quite according to plan but only one discrepancy so far is thought to be a machine fault.
This latter fault occurred on a previous test sequence and consisted of failing

to clear certain store positions which later were added into the accumulator assuming that they held zero.
This fault was pursued as far as locating an undesireable digit in the mier tank but the why of its being there has not been explained. The H C and V tests are all performed without a hitch.
When the programme was put there again with an amendment to cure one of the program faults the ~~same~~ machine error did not occur but it stopped occasionally in taking in the data (always in the

[[NB07-031]]
same place) and had to be set going again manually.
This morning the reader is to be dismantled so that ~~the~~ it can be assembled on to the new dual reading desk
This will enable a composite programme taking in programme and data in turn to be used on the new Bakery sales job

10-7-51

Before ripping the reader to pieces yesterday another test on the BS programme was made. This failed due to corruption of an order in tank 7 and on examined it was found that a spike was cropping up here. Previously the gain control of the unit had been adjusted for the removal of the spike. However the control was adjusted again and the programme put thro again. This time everything went OK and the results obtained appeared to be more correct and complete than any previously obtained.
TRT had a visitor to show

[[NB07-032]]
the machine to today "Mr Edward Sister" Leo did the Payroll programme without fault.
The reader when put into operation proved more troublesome than was expected, and we (Gibbs & I) were still struggling at 6PM yesterday
The symptom as diagnosed by the Input test Tape is that holes are being read and stored ~~before the tape was~~ without stepping on the tape or else the input operations are being carried out for one tape feed.
This could be caused by lack of suppression of

the R_2 pulse by C27, for when [[400]] I orders succeed each other if the R_2 end pulse

starts the second sequence the relays operating the tape feed mechanism will not recover in time to act on the second order although the coder and coincidence waveform will be produced to stack the new row of holes being read.
To check this a piece of tape punched 0 1 2 3 4 5 6 .. 15 and read in with a series of I orders should fill the [[bill]]
I_{16} I_{17} I_{18} .....

[[NB07-033]]

11-7-51

So many faults were shown up yesterday on the new tape reader that it was decided to get back to the original one as soon as possible so that a detached investigation of the shortcomings of TR2 can be made.
Main faults were.
1. Indefinite Paper drive
2. Peckers not correctly adjusted
3. Bad phasing of peckers & sprocket
4. [[Octant]] not defined enogh

I spent a good deal of time making measurements on the old reader with a view to setting up the new reader to the same conditions.

So far I have found that the pecker adjustments were completely wrong and that there was excessive flux leakage on the magnetic circuits of both the TF & pecker solenoids.
Also the movement of the TF ratchet was insufficient to guarantee that the sprocket would be pulled round one step every time.
The clearance between the sprocket wheel & the tape clamp was such that a slightly worn tape just slid over the top of the teeth

[[NB07-034]]
The simplest adjustment to counter the latter fault is to mill out the slot accomodating the sprocket spindle by some 6-8 thou so that the sprocket itself can be raised.

Friday 13 July 1951

The old tape reader is back in service and LEO has done some good work. Unfortunately some decode trouble wasted an [[couple]] of hours Wednesday evening and Thursday morning and then again yesterday afternoon a broken wire on the tape reader caused some trouble (a really flexible coupling is called for) Also on putting the old reader back into service one of the pecker contacts was found to be failing and had to be readjusted. Then we learned that the alternator was giving trouble and that

[[NB07-035]]
a shutdown was necessary so that a new bearing could be fitted. This shutdown starts this morning and will give us an opportunity to get the best part of the mods necessary for Input changeover.
There are also many wiring connections to be put in more permanently so that the days respite can easily be absorbed.

1. Mod for endpulse from CO order
2. ~~Delay C_{2T} in Coder II~~

3. ~~Wiring of HS control lines~~
4. Making Transfer Unit Pulse wiring more permanent.
5. Cleaning up mod sheets & other clerical commitments

[[NB07-036]]

Monday 16-7-51

Last Friday work went ahead with mods to 3 units and much pulse rewiring. I did mods to Coord Control II (LC10) and Coder II (LC21) providing a delayed C_{27}- I also cured a fault on the latter unit which was due to not having been wired up correctly. Provision has also been made for inhibition of end pulses during the input changeover order. Two extra inputs were needed on LC21 and Kaye started on a mod to CCU IX LC39 which happened to have the necessary gates

& mixer available for the production of the required end pulses. This should also put paid to the trouble with W_{12} staying set after initial input and manual input, as it is now arranged that order P & Z produce end pulses which are inhibited.

[[NB07-037]]

Tues 17-7-51

Power OK this morning but did not switch on until this afternoon as mods were still being made.
So far none of the mods carried out have been shown to be entirely satisfactory
1. A fault on the reader wiring puts a permanent pulse in the D_2 position of the initial orders
2. "P" order produces an end pulse during ~~initial~~ starter orders
3. Z order end pulse is not suppressed due to incomplete state of Operating Control Unit ("Inhibit end pulse" waveform not sent.)
4. Annexe Input system

works partly but pulses are not large enough (only 8 volts at input gate of store.)
Have suggested that a mixer amplifier on same lines as in Transfer Unit be incorporated in the Annex distribution unit
It is hoped that today the fault on the reader will be cleared so that tests on the changeover order can be made.
Clements (instrument maker) and Crowhurst (wireman) started ~~today~~ yesterday and Turner will be starting next week.

[[NB07-038]]

Friday 20 July 1951

Wednesday the machine was partly operational but late afternoon produced inconsistencies. Earlier I had trouble with the store At first it was assumed that the hot weather might be the cause but a detailed examination of non circulating unclocked pulses suggested much more serious trouble ~~Furt~~ I went all thro the store and made tracings of oscillograms these showed that not only was there considerable phase difference between tanks in the same battery (No 1) but that serious distortion of pulses (widening and running in) was present. The first battery (No 0)

(No 0 late Nos 9 & 11 early)

had only three tanks ~~(No 0)~~ which differed to any extent from the others, but these

differences were small compared with those in Battery 1. ~~Fortun~~ In order to discriminate between tanks and panel 1s I changed around units connected to early and late tanks without changing the readings. I also used "good" panel 1s on tanks in the second battery (No 1). This latter test was interesting as it showed that while the Panel 1 had little or no effect on phase, where the pulses were previously very narrow they became much wider and

[[NB07-039]]
ran into each other.
Fortunately tests had just been completed on Battery No 2 and I substituted this for No 1. The superiority of this battery was at once apparent ~~Ap~~ A tracing of an average tank in Battery 0 was compared with oscillograms from Battery 2 and no measurable difference could be seen on any of them.
Battery No 1 has now been thro an ~~d~~ attenuator check which shows that there are in fact tanks which possibly have broken crystals or obstructions. Fredericks is building a wide band amplifier to investigate

the nature of the troubles.
Yesterday showed up faults on subtraction and conditional transfer (E) The latter seemed elusive and vanished at a touch of the control ampliying D_9. Subtraction was more persistant but not so easily found until I examined the subtractand which was drooping badly.
Adjustment of P_1 on the complementer stopped the faults but did not completely cure the droop which seems to be due to an amplifier which is not limiting.
At this stage further faults on all functions started up and it was sometime before

[[NB07-040]]
I noticed that this happened when the teleprinter was running and was due to slipping of W_1 waveform. This trouble is still with me.

Later
Trouble of W_1 was due to a faulty condenser in the Flip Flop. Then a fault on Store 22 caused a deal of trouble. By about 3pm however all my troubles seemed over for a while and a few programmes were tried out. They seemed to work out fairly well and one of them - using the input changeover system

worked very well & attracted a good deal of attention
When later we tried to repeat it for Mr Thompsons benefit however, it failed miserable. Barnes was quite happy of course as we had proved his programme correct.
The fault may be one similar to the fault on store 22 or again it may be subtraction.
Progress has been made on input Annexe & it may be possible to do some transfers on Monday.
Gibbs appears to be doing well with the Character Generator & that too may be ready soon

[[NB07-041]]

Monday 23-7-51
Apart from some initial phase difference between the two batteries this morning there has been little trouble on the machine today. Barnes and Hemy have both put in long

& complicated programmes and have generally found that when the wrong thing happened this was due to a fault in the programme.
Shaw & I did some work on connecting the Annexe Input up and it seems that the trouble of corruptions of pulse patterns has been overcome by the insertion of

the amplifier.
It should be possible tomorrow to do several HS1 orders in succession switching from one annexe to the other but so far we are waiting for a mod to a flip flop which gives the ready - unready signal.
The biggest part of the Bakery sales programme is finished now and the demand for the character generation becomes more insistant.
I understand from Gibbs that this is very nearly ready and we must

[[NB07-042]]
be preparing for the installation of the new unit.
Barnes has produced a most impressive program utilising the two readers and a changeover order. The programme proper is read on reader 1 after which the permanent data follows on the same reader with the current data on the second reader. After the program is taken in, the machine stops, and has to be restarted in order to work on the data.
The interchanges of attention between Reader

1 Reader 2 and the Teleprinter are fascinating - a few rows from No 1 a single row from No 2 a burst of printing more from No 1 still more from No 2 and another burst from the teleprinter
It is a fine example of automatic control. LEO has done this job completely (it takes about ½ hour) 3 or 4 times.

[[NB07-043]]

Tues 24-7-51

This has been a bad day. Starting off with a fault on Tank 18 apparently due to narrow pulses I then went to the frequency control unit which was showing much more than the usual signs of jitter. A small mod on this unit improved matters slightly and I then tried to do some test programmes in vain. It was a case of the old trouble "Order 29". There seemed to be no definite fault that could be pinned down so after a long period of unsuccessful logic I began to try short random programmes

One of these doing a repeated subtraction had 27-0-17/3-0-17 at the end. After only a few times round the loop it failed on the 3 order. I could find no obvious cause of failure, the D_9 pulse when it was produced was simple. Eventually I looked at the S_1+S_2 pulse and immediately everything worked again. ~~Thi~~ I have found two suspect joints which have now been resoldered but the fault remains a mystery.
This trouble has once again brought to the forefront the

[[NB07-044]]
need for my supplementary initial orders and a series of test programmes

[[DIAGRAM - CYLINDER]]

Wed 25-7-51

More trouble with initial orders again today probably due to occassional failures of Left shift.
Have been considering recently the possibility of using one of the IFF stepping switches in order to put in the simplified initial orders

My scheme is to ~~operate~~ turn a brass tube about 3" diam by means of its switch. On the surface of [[its]] tube will be contacts screwed into threaded holes at carefully spaced intervals around the tube. These will make electrical contacts with a bank of contact leafs supported on the framework of the switches. The bank of contacts will consist of 14 leaves 11 of which will operate M gates relating to D19 to D24 and D31 to 35 the remaining rows of contacts will be required for control puposes.

[[NB07-045]]
Required
11 rows for digit contacts
1 " " end pulses
Contacts for digit pulses will be as large as possible say ¼ inch, [[with]] end pulse contacts will be much smoother and phased [[so]] that the end pulse can only occur while the DP contact is made.
I have discussed this possibility with JMMP but he does not think that time should be spent on it at this stage. I propose to put the idea on record however

Progress Meeting

Lecture on Bakery Sales Job.
Date of start of job
Work while on Holiday
Notices of future Meetings

Work in Progress

1. Annex [[output]]
2. Double output ([[Reperforate]])

---

3. Double Store
4. Improvement to Freq Control & Batteries
5. Control Desk
6. Valve Testing
7. Alteration to Teleprinter
8. Photoelectric reader for tape & documents
9. Typewriter to Magnetic Tape

[[NB07-046]]

Monday 30 July 51

Spent the day on Annexe tests with Shaw. There seems to be some state of the circuitry which prevents two High Speed Input orders happening within a short space of time. Kaye is investigating this. Gibbs has finished mods to the Output Unit in preparation for the Perforating equipment and so far as can be seen from standard tests LEO is back to normal. I have written a brief note on the new starter switch.
It seems that in order to get any new inital orders into use I will require to rig up

some temporary switching using probably 2x12 way 12 bank Yaxley Switches in

conjunction with a push button. [[Alternatively]] it means rewiring the present starter switch & making up a plug board so that the two sets of orders can be interchanged. This latter scheme would be nearly as difficult in making up a completely new starter switch. In order to be able to use the new orders too it will be necessary to have suitable programmes punched in the necessary code and it seems that the easiest way

[[NB07-047]]
to do this is to get a programme made up which ~~will~~ perforate a tape in the new code containing the orders of any programme that has already been stored in the machine.
Hemy has made up a new set of initial orders which takes in pairs of orders and stacks them in long number positions. This will cut down the input machine time as compared with the present method by a factor of 5 or 6 but it will be a bit more complicated to read off a tape

25 Aug 1951

AC (Red) 230

+250 Un	244 252
+250 Stab	242.5 250
-200 Un	186.5 198
+250 Stab	190.0 195

Voltages set up to within ±½ volt as read on Control Desk.

[[NB07-048]]

26-8-51

After return from holiday last week I managed to get the machine operational to the extent of clean tests but the new perforating equipment was not operating correctly so that PI program was not possible. After a few hours [[frigging]] the Perforator was made to work but further work was prevented by preparation for a demonstration to Sir Thomas Spencer the ST chairman Just befor the demonstration last Friday the machine failed on the Payroll programme but carried out the others

without trouble. Afterwards it was found that in some way the machine was voltage sensitive causing Payroll programme to fail. Limiting tests using A4 and varying voltages did not show up the same type of fault.
Yesterday all the voltages were adjusted to correct values ~~so that~~ ie 230 v AC and +250 and -200 within ±½ volt
However many other faults appeared on the machine after this one of which - in the starter unit, has prevented further tests so far

[[NB07-049]]
The fault on the starter has the effect of sending all the end pulses as D_9s so that the initial orders are not stacked. Late last night I located it to the starter unit so that this must be investigated this morning.

---

4 5-9-51

During the last two weeks there have been a series of faults on the machine which have ~~qu~~ caused ~~quite~~ trouble for a few hours and then disappeared without trace and

without my being able to trace the cause
One of these was the starter fault mentioned in the last

entry. Some of them have been on the second half of the store where several tanks have been shown to be "too good" for the panel 1. A modified panel 1 has been done ~~for~~ to combat this but yesterday this modified unit itself decided to break down. ~~A~~ Two completely new batteries are in use now both filled by Fredericks The one filled by Gibbs has been rejected entirely. One tank out of the last battery has failed but apart from the fact that it failed quite suddenly (possibly broken crystal) ~~the~~ nothing is known as to the cause.
The collater and convertor

[[NB07-050]]
ex STC are wwith us but neither work very well, the collater not at all!
Yesterday after a dreadful morning due mainly to ~~the~~ an HT short on the Frequency Control Unit, P1 was tried with real data and this resulted in the longest fault free run on one programme yet made by the machine. The programme was started in at 350 and it churned out printed results and punched tape until 535 without a halt.

A policy meeting this morning had a good effect in bringing into the open the question of machine time allocation. There are three demands
(a) That the machine shall be operational for the programmers
(b) That desirable modifications shall be incorporated to give better working
(c) That development work shall proceed on the annexe system and other things such as character generation - control desk etc.

[[NB07-051]]
(1) Coord Control III (II)
Relay F_1 to $P45^{15}$
(2) DC flipflop for TCT SU
(3) Rewiring of Operating Control.
(4)
==========
(a) Accumulator
(b) Discharge line
(c) Transfer Unit & Tanks
(d) Feed Line
(e) Decoding
(f)

11-9-51

Apart from the usual run of faults there appears to be evidence that ~~the~~ LEO may suffer from an occasional loss or gain of a digit in the store.
Only by this reasoning can isolated faults in long runs on the P1/3 programme be explained The corruptions seem to occur during long operational runs on the machine and the problem is to devise tests which will search out such faults.
~~Possibilities~~ Causes of such faults are difficult to imagine l other than those already tested for

[[NB07-052]]

12-9-51

[[DIAGRAM]]

[[DIAGRAM]]
Double photoelectric tapereader.

Interconnect I Annex & O annex

X in Tank 3
ASO

[[NB07-053]]

12-9-51

Most of today spent in a rather unsuccesful attempt to explain why tapereader 2 occasionally "reads in between the lines"
It appears that if, as seems likely the C relay is slow to release it may get caught [[lending]] by the next input order.
This has brought to the ground all ideas that the present system of relay interlocks is foolproof, and it calls for a redesign of the whole tape read system

Required.
Initial state:- peckers up
Stages in operation
(a) Peckers down
(b) Tape feed
c Peckers released
(d) End pulse.
Tape must not be moved until peckers fully withdrawn
~~End pulse must not be given until~~ Peckers must not be released until tape has finished moving
End pulse not given until peckers fully released

[[NB07-054]]

[[DIAGRAM - CIRCUIT]]

13-9-51

Possible ~~Start~~ Reader relay arrangement

[[DIAGRAM - CIRCUIT]]

[[NB07-055]]

Photoelectric turn reader

desired Single optical and photoelectric system with twin tape feeds operating from some stepping mechanism. A shutter coupled to changeover gear switches optical system and drive from one tape to the other

[[DIAGRAM]]

[[DIAGRAM]]

[[NB07-056]]

17-9-51

Character Generator

[[DIAGRAM]]

All three [[tenslate]] gas tubes normally rest on position 1. When DTA is triggered the discharge jumps from cathode 1 to cathode 2. During operation the DTA is fired at 200 μS intervals so that if the first is fired at time 0 then discharge jumps as follows

	Time	
1 to 2	0	0
2 to 3	200	1
3 to 4	400	2
4 5	600	3
5 - 6	800	4
6 - 7	1000	5
7 - 8	1200	6
8 - 9	1400	7
9 - 10	1600	8
10 - 1	1800	9

[[NB07-057]]

19-9-51

Another fault traced yesterday. Some days ago I had found that occasionally the A1 Test failed on all sequences with the exception of G & E. The cause had been the loss of the constants used in all the other tests which are ~~provided or~~ derived from two Y orders at the beginning of the programme. At the time a test on Y order failed to show any faults.
This fault eventually disappeared ~~but~~ only to reappear for a fleeting moment yesterday. I failed to trace it in the short time I had in

the morning and at dinner time the P_2 programme was put on. At the end of this ~~the~~ it became obvious that the Y order was failing again (1½ hours wasted) so I went back to it and eventually found a dry joint in LC29
A second run on the P_2 programme failed towards the end due to part of the store being overwritten in error. It was found that the two tapes had got out of step. This may indicate that it would be desirable to incorporate checks on the two tapes to ensure that such a fault does not happen without drawing

[[NB07-058]]
attention.
During the last two programme runs I have been able to look around and get some overdue jobs done.
(1) I have now to consider where the present machine tests fail and how they could be changed to become more searching.
(2) Consideration of controls required on control desk and how they are to be obtained.
(3) Frequency monitoring and alarm system

(4) Study of Annex system
(5) Modifications required to units and wiring

(6) Manual on machine tests & fault finding.
(7) New starter orders
(8) Twin reader system.
(9) Conversion and Reconversion
(10)

[[NB07-059]]
New tests required.
(a) X
(b) Y
(c) Store clearing tests
(d) HSI
(e) HSO
(f)

Future Programme of Work on Leo

(1) Control Desk
    (a) Monitors
    (b) Operating Control
    (c) Starter
    (d) Audible indicator

(2) Rewiring of Coder Rack
(3) Provision for Second Half of store
(4) Modifications general

[[NB07-060]]

Progress Meeting 25-9-51

(a) Frequency Control combine with Monitor
(b) Battery's No 2 out
(c) Annex Inlet replacement of units
        Wayne Kerr and Crowhurst
    Outlet tests completed
        Mods required
(d) Photoelectric reader
    almost complete mechanically
    not started electrically
(e) Changes to calculator
    new mixer circuits for 5 [[junct]] Unit
(f) Power supplies
(g) Control Desk
    i Oscilloscopes
    ii Audible indicator in production
    iii Tape Reader ~~circuits~~ (
    iv Operating Control
(h) Test Gear

Oscilloscope

Byron

[[DIAGRAM]]

[[NB07-061]]
Progress is being made now on the control desk. 3 of the monitor scopes are working (SCT & OT) (Counter) and (Accumulator). The trace on the accumulator is too confined to give clear representation of digit positions so I have suggested that only the more significant half of the accum is displayed with the lower half available on switches.
The Raster etc has not proved satisfactory as yet and these are to be finished next With the raster on the control desk the need for "switching" circuit to select the tank. A lot of thought

has been put into finding an economical circuit to put in as a modification to Storage Junction unit. The first idea was a crystal gate & mixer circuit which was tried some time ago but which did not work. I have now produced a circuit to try which seems very economical. It consists of 9 ~~double~~ half ECC33 8 of which are DC coupled from the ~~gr~~ A links of the panel 1's. The cathode are normally returned thro ~~100 K~~ 1 Meg to 30 volt line than [[bracing]] them off. Each cathode is also taken thro 2K2 to a switching line which can be earthed at the control

[[NB07-062]]
desk. Each cathode is also taken thro .001 to a common feed line which feeds an output CF which has a similar switching arrangement (cathode thro 100K to 30v and also thro 2K2 to a switching line) the output from the cathode being taken thro a .001 condenser to a feed line which is common to all storage racks.
The success of this circuit would appear to depend on the capacity of the switching lines as the selected cathode has across it not only at the other cathodes but all the other cathode circuits in series with its feed condenser

[[DIAGRAM]]

Try

[[DIAGRAM]]

What value of C is tolerable?

[[NB07-063]]
It would seem that even with heavy resistances of 100K the attenuation would be severe so that probably 1 Meg would be better In the final instance the capacity of the switch lines may decide the [[wire]] but it may be possible to reduce this to a minimum by treating them as pulse leads as there need only be 16 of them

[[DIAGRAM]]

[[NB07-064]]

30-9-51

More runs have been done on the Bakery Sales job but there are still troubles to be overcome.
One is the Character Generator which occasionally goes crazy for no apparent cause
On Friday however P_2 failed three times. The first time it was due to the new tape winding scheme which was much too ~~F~~ vigourous & tore the tape The second two faults were a much more mysterious failure to construct an order.
The symptom as far as can be seen is that either

the 5 order fails to clear the accumulator or the accumulator fails to add correctly.
Needless to say all the usual tests are performed quite happily.
I have been trying to summarise my fault sheets with a view to :-
(a) setting up some sort of training scheme for "[[genning]]" up Shaw and any others who may be required to maintain the machine
(b) Devising the best test programmes for fault chasing
(c) deciding where best to institute marginal tests.

[[NB07-065]]

1-10-51

More runs on Bakery programme today and more trouble. After quite a bit of bother it was found that tape reader No 1 ~~was~~ had not got sufficient grip on the tape to permit it to tug the tape spools around and tapes were damaged. After this spasm a complete run on P_2 was achieved. An attempt was then made on P_3 but a fault which manifested itself in a dropped digits in an order (A_2 17 to A_{17}) stopped this early on. No reason could be found for this so a new start was made and this time it seemed

to go well for a while until about a minute before Mr Simmons came down to see it. Then of course it started producing rubbish.
No sense was got out of it so the PM tape was used to produced a beautiful example of printing which may or may not have the solution to our problem.
JMMP has produced a mod to my suggested scheme for Store selection gets round part of the trouble of loads on the CF outputs
He puts ~~the~~ ~~his~~ my two alternative loads in series and ~~earthes~~ takes the junction thro the switch to -50 volts.

[[NB07-066]]

15K

[[DIAGRAM - CIRCUIT]]

2-10-51

More trouble today with P_3 but it seems that we may be on the trail of a flaw in ~~the~~ either the programme or the data
At the same time JMMP has pointed out that the spikes appearing on the input output and clear waveforms of the store may be causing some of our trouble.
Inspecting these spikes today it seems that they occur at the back edge of a D_0 and last long enough to cause doubt whether enough of D_1 might be gated by one to be transformed into a fullsized digit. It is assumed that these spikes are

[[NB07-067]]
due to the crossovers of + and - tank No SR waveforms at the time of resetting. These may appear
(a) Positive on Input Gates
(b) " " Output Gates
(c) Negative on clear gates.
If we consider (c) first. It is possible that a negative spike on a clear gate might under favourable circumstances clear a D_1 in error. This is a possibility which should be considered but it does not line up with any programme troubles we are at present experiencing
Positive spikes on input

waveforms. This ~~would~~ might let into store any D_1 that was on the feed line at the precise moment of the spike. This could be any result of
(a) Transfer or Copy Order
(b) Input Order
But it would only manifest itself in the even storage positions and would be the effect of a D_{18} delayed by half minorcycle or a D_1 delayed by one minorcycle (Note it could only be a D_{18} ~~from~~ in the case of the reader.)
Positive spikes ~~from~~ on the Output gates could send D_1s from the stores to the transfer unit and in the absence of F_1 or

[[NB07-068]]
F_2 would receive a full minorcycle delay so that they would not arrive at any input gate until 72 μS after ~~and coincidence~~ all coder waveforms had ceased. similarly they could not be gated into another storage unit. For this reason it is not likely that output gates to which these spikes are sent should cause any trouble

To examine effects of these spikes.
(a) Fill all store with clock ~~pu~~ then with 2 order programme
try effect of combinations of tank decodings that will produce D_1 on discharge line
(b) Hold up input coder so that digits from reader enter Feed line then with clear store try combination of tank decodings to produce spikes. Where spikes are found investigate amount of breakthro into store due to these.

[[NB07-069]]

3-10-51

It seems that the fault on P_3 is produced by errors in both programme and data so that the machine is absolved from blame.

4-10-51

Yesterday brought a complete reversal to the general dispondancy created by the persistant failures of the P_3 tests.
Two subtle faults, one in program and one in the data caused the breakdowns and when these were put right, a new test showed that a revised input would put things right.
Later in the afternoon

the job was completed and even the presence of Mr Simmons did not cause the usual breakdown.
On the strength of what he saw a demonstration for the directors was arranged for Monday. I hope it works.
I have tried out my new switching circuit for the raster scope and it works quite well. I am

preparing the way for mods to be done on the Storage Junction units. My worries on the score of line capacity was ill founded and the original wiring scheme will be used.
We also investigated

[[NB07-070]]
the possibility of the TN Decoder spikes gating is ~~"1"s~~ D_1s into the store and although the programme used did not cause a 1 to circulate inspection at the input gate showed that there was a genuine chance of such a transfer.
The solution seems to be to eliminate the spike.
The first steps in using the machine as a musical instrument was made yesterday when Hemy devised a program which produced two notes a fifth apart each lasting some 2 or 3 seconds and being repeated

Materials
Labour
"Cooking"
Assembly
Distrib Selling
Selling Price

Gross Profit
2 Tapes
Prices & Rates Quantities
P_1
Revision of Prices and Rates

[[NB07-071]]
Price revision
Item 157 Amendments
Selling A
Selling B
.
.
.
.
.
.

Common Rates
Rates common for Bakery
Rates for each item

P_2 Rates
Sales each channel at SP. GP. Dist.
Assembly FPC

Value of sales for each channel
" " " " " channel Group

Quantity of sales

P_3
Sales values
Total Sales quantities
Rates
Bakery Output each line
Stocks
" Differences

[[NB07-072]]

5 Oct 51

More trouble from the character generator today when P_1 was put on the machine. This programme had to be abandoned and the CG is being removed for thorough investigation today.
Another trouble today was a broken wire inside the tape reader. In view of the vibration in this unit I think it is advisable for the wiring to be done in flex anchored down at all possible places.
Dutton has ~~removed~~ taken one of the Storage junction Units with a view to modifying for the switching circuit. The

replacement failed to work because a crystal zero restorer on the clock pulse had been reversed. This error occurs on the [[digression]] which shows the need for testing even the simplest modification
~~I~~ On the subject of decoder spikes JMMP has shown that the cause of these is the inability of the cathode follower feeding the routed waveform to hold down the gate when all other inputs are up. With [[66]]K load the total diode current of a gate is 250/66 = 4[[mA]]
[[DIAGRAM]]
so that for every 4 way gate held down by a cathode ~~3 mA~~ [[it is]] possible for an extra 3mA

[[NB07-073]]
diode current to be poured into the holding cathode.
Back routed waveform CF holds down 4 gates but fortunately on only one of these at anytime is it completely unassisted

[[DIAGRAM]]

= 12 milliamps
The present cathode load of the feeding CF is 22K taken down to -200v. It is obvious that the 12 millamps will tend to cut the cathode off so that the gates will rise. The solution is to

(a) Reduce diode current by increasing diode loads. (This uses less current)
(b) Reduce Cathode follower loads (this uses more current)
As an experiment the latter is being tried as it calls for less mods. The cathode loads in the SJU are being reduced from 68/3 to 68/4 = 17K
The effect of this modifification tested rather briefly (with ~~an~~ orders A 7/0 E0 and

inspecting input & output gates) reduced a 12 volt spike to 3 volts.

[[NB07-074]]
~~Gas Tubes~~
One Storage Junction unit has been modified now for the new switching circuit and is awaiting tests. In order for this to be done a lead must be made up for the switching lines.
It was decided today that the Bakery programme should proceed without the Character generator. This means that the consolidation of price revisions (P_1) should be done manually and that ~~P_2 sho~~ the results of P_2 should be printed instead of perforated so that a manually produced

tape has to be made for P_3.
P_2 was completed this afternoon and the tape for P_3 should be ready by Monday noon.
Gibbs has tested all of the selenium rectifiers in the Character Generator and has found at least 3 faulty so that it may be that the CG will not be~~e~~ out of service too long although I would personally like to see very extensive tests of this unit before placing any further reliance on it.

[[NB07-075]]
Work required to be done ~~for~~ on Monday.
1. Wiring of Storage Racks for A link switching
2. Making up of cables for switching Raster line.
3. Further mod to Storage Junction unit

Hemy has produced an almost recognisable God Save the King from the machines loudspeaker. Unfortunately it has not been possible as yet to produce all the required notes and the results are amusing if not musical
His system is to put in a program consisting of a store of notes and then a data tape which calls out the

notes as required. Each note is produced by a Collate E order with the orders so placed that the frequency of repetition gives the required note. The tone is reed like in quality but occassionally one gets harmonics at awkward frequencies that make the note very rough.

I have repaired the Raster Scope which gave out yesterday. The trouble was multiple. Bleeder chain gone low. Focus P of [[game]] low. Smoothing resistance open circuit.

[[NB07-076]]
LEO as a Musical Instrument
Oneway of doing simplified tunes on the machine would be to use the acc clear button as a key and then with a programme of the type

0	A_x	The sequence
1	G_1	G_R would be repeated
2	A_y	until the acc was
3	G_3	cleared.
4	A_z	

5 G_5

This would leave the duration of each note to the discretion of the operator

D	TDRMF
D	
R	
T	D = x
D	
B	R = ax
M	
M	M = a^2x
F	
M	
R	0 A_x
D	1 G_1
R	2 A_0
D	3 ~~UvH~~ R_1
T	4 G_3
D	5 A_0
	6 R_2
	7 G_6
	8 A_0
	9 R_3
	10 $G_{0}09$
	11 $A_{x}0$
	12

[[NB07-077]]
Required a method of Binary/D & DB conversion.
If it is assumed that there could be provided a static register (full meaning) containing all the binary forms of decimal equivalents which could be called upon to be added or subtracted into the accumulator in some sequence similar to the multiplication then
(a) Conversion
1 to be added into the ~~computer~~ acc as my previous scheme.

[[Reconvertion]]
Subtract or Add as in division but when subtraction is excessive when going from 100 to 10

1010 (10~~0~~)
1100100 (100)

if No in 33

Subtract	800	
	- 767	0000|0001|0001|
Add	400	
	- 367	32
Add	200	- 80
	- 167	- 48
Add	100	40
	- 67	- 8

Add 80-32	48		20.
	- 21		12 1
			- 10
			2 1
			8
			- 6 0
			4
			2 0
			2 0
			0 1

[[NB07-078]]

	64		
	80		
	-16	0	
	40		
	24	1	
	20		
	4	1	6
	10		
	-6 -	0	
Add 8-4	20		
	-2	0	
Add 2	2		
	0	1	4
		0	
		0	

It seems that there is a reasonable chance of building a converter reconverter into the machine at the expense of about 2 racks of equipment and which will do the conversion in approximately the same time as a multiplication sequence. The conversion would use the same principles as now used for multiplication but there would be a permanently wired in ~~generator~~ register holding the conversion numbers. Reconversion would be done along the same lines as proposed for division and also would use

[[NB07-079]]
wired in constants.
Gates
I must investigate the possibility of using the switching gate which I have designed for the store switch for general purposes throughout the machine
Where numbers are gated by means of a single waveform~~s~~ eg panel 1. a large number of diodes and triodes would be saved if a negative waveform were applied to the cathode of a cathode follower instead of thro the usual gating arrangements :-

[[DIAGRAMS]]

The waveform normally holds up the cathode so that V_1 is cut off when the waveform occurs the cathode is taken down to earth (or lower) and V_1 conducts permitting the number train to pass thro by normal cathode follower action. This should be a much

more efficient gate than the usual one provided that the waveform is large enough

[[NB07-080]]
as it only involves the loss due to one cathode follower instead of two and there is no loss in diodes
In addition a large current saving should result as no standing current is required in V_1 and the 10 volt rail should not be necessary.
One possible snag is the fact that the pulses may stand on a step as the valve will normally be cut off and the sudden returning of the ~~gaid~~ cathode to earth will result in a standing current in between pulses.
This may however be overcome in other ways

Where more than one waveform is used to gate the number train the effect might be achieved by gating the waveforms together first before applying this to the number gate

Cathode potential

[[DIAGRAMS - WAVEFORMS]]

[[NB07-081]]

9-10-51

Several troubles hindered the completion of P3 yesterday. First of all the Tests threw up a fault on Right Shift. Then A negative number subtracted from itself left the most significant sign digits still is the accumulator Both these faults were corrected by "frig pot" methods and need to be looked into in detail. Then a failing in the store called attention to the fact someone had switched the fans off in the vaults. This fault ~~was~~ corrected itself after about an hour of switching on and I left Barnes & Hemy

with P3 going in for about the fourth time.
I have put in a plea that when the machine is not so affable, we should not persist in trying to "frig" it to work, but to insist on an "unserviceable" decision so that work can be done more thoroughly in order to correct the known shortcomings of the machine. This means going back to the marginal checks as a matter of course.

[[NB07-082]]

10-10-51

Had a shut down today during which quite a lot of mods were carried out
(a) Cable for Store switching was laid under floor & connected up to control desk (One rack only)
(b) Mod to Coincidence unit to provide negative waveform to Annex.
(c) Mod to Majorcycle pulse generator to satisfy Annex requirements
(d) Two more units have been shifted on the Coder Rack
I have been examining the requirements of the various racks in the way of digits & clock pulses It seems that the termination of

the digit pulse lines is far from satisfactory and a more detailed consideration of the ~~mods of~~ distribution is required before the proposed modification to the C & D Distributing unit is carried out.
Yesterday I explained my scheme for Conversion & Reconversion to JMMP and I

think he was impressed. I have calculated that the simplest method of producing the various conversion numbers would use up something like 10 units including 3 Digit Pulse generators to provide digits not already produced. It relies on a wired in register of

[[NB07-083]]
all the conversion numbers required each of which would be chosen thro a decoding network.
It has been agreed that I should have a D grade girl to assist in keeping the necessary records of maintenance & serviceabililty of the machine She would take notes of all maint as it is carried out and also keep a log of all work done on the machine.

In order that a record of machine time should give as much information as possible without a lot of research it is desirable that it should be dissected in a pre calculated form
Suitable headings have been suggested by Mr TRT

1. Productive	
2. Programme Trials	
3. Demonstrations	Serviceable
4. Routing Testing	
5. Off	
6. Fault Investigations	Semi Serviceable
7. Minor Modifications	
8. Routine Modifications	
9. Off	

[[NB07-084]]

10 Fault finding	Unserviceable
11 Major Modifications	
12 Power Failure.	
12 Off	

	Productive
Serviceable	Non Productive
	Routine Tests
	Off
	Fault Investigation
Semi Serviceable	
Unserviceabl	Modifications
	~~Fault Investigation~~
	Power failure

11-10-51

In view of the decision to take on a girl assistand operator it is desirable to have a fairly clear idea of how her time will be spent.
The most important part of her job will be to maintain an up to the minute account of

work on the machine particularly during fault finding ~~when a p~~ a time when in the rush important steps in reasoning may ~~be~~ fail to get reported.
(a) Detailed report on fault finding as work is in progress. (Fault Sheets)
(b) Putting on normal test tapes and recording results.
(c) Keeping library of test tapes up to date

[[NB07-085]]
(d) Maintenance of Machine log & keeping records of Productive work attempted and completed
(e) Recording Modifications pending and carried out.
(f) Controlling movement of units in the racks
(g) Control of Valve ageing.
(h) Machine Meter Readings (daily.)
(i) Periodical Valve Current Checks
(j) Control of Unit Record Cards

Type of Girl required
Age about 16.
Neat in appearance.
Legible hand.
School Cert or Matric with leaning to Science.
~~Shorthand an advanta~~
Methodical
? Union

[[NB07-086]]

[[DIAGRAMS]]

15-10-51

Still in a state of shut down. Clock & digit distrib unit has now been completely modified and I am carrying on with TCTSU. This latter unit has been quite a beast to rewire but it is now almost complete.
I have had to make one more change to my original mod to provide for an initial reset to the flip flop to ensure that it is in the right state when it is called on.
Tomorrow morning I will try to get the machine operational without the TCTSU while Crowhurst carries on where I

[[NB07-087]]
left off. There are still a few terminations to be added to the digit pulse lines before we start Wheeler [[off]] doing that at present. Also some of the mods to C&DDU ~~ha~~ require ~~different~~ alterations to pulse wiring.
There are still 4 more units to be shifted on the Coder rack before the Coddr II can be permanently housed.
Gibbs is back today and proceeding with the Character Generator it is still questionable whether this unit will be available for work when we [[resume]]

Caminer hopes to get some programmes checked on Wednesday I hope we are ready to do them
Personnel dept is on the look out for Assistant machine Operator JP & I have laid

down a list of jobs she would do and given some idea of qualities desired. From the letter it seems we may have to wait some time.
In interviewing applicants for the job I think it would be a good idea to dictate some typical technical phrase to her so as to get an idea of her ability to write [[illegible]] and quickly.

[[NB07-088]]
32 way ring counter
16 double triodes

[[DIAGRAM - CIRCUIT]]

16-10-51
After a great struggle I managed to get the computer to produce a clean sheet this evening, although I had two failures at the end of the evening due to a failure of the W2 flip flop to reset.
I then put on the long A3R test and had stacks of failure although the A1 test had been done without failure.
I investigated this and found what appears to be a flaw in the logic in producing AD3. This is a comparatively new method which adds in one additional digit at each circulation. As it was

[[NB07-089]]
connected An even D0 was used to inspect the sign digit of the accumulator in ACCSU and the resulting digit sent as AD3 thro the ACC.I.O.
It seems obvious that this digit [[shown]] ED1 and in fact the ED1 works quite well.
Incidentally there is quite a large part of LC32 which is redundant as a result of the original huge
first D_R - 1D1
S_2 - 2D18

<u>AD3</u>
Even D_1 gated with C7 = D_R
D_R gated with No in acc at
entry to first Half Adder = P_R AD3
<u>AD3 input 37^2 Acc Input Output</u>
C7 starts at D35 say old 35
C6 gated with S2 produces W8
W8 gated against Even D_0 to produce (O)D_0
OD_0 delayed sets W5 at (O)D1
Order gated by Dy sets W16 which
gates Even D_1 to reset W5
Even D_0 of some minorcycle is EP
to remedy this possible addition of extra AD3 Even D_1 should be gated against a delayed ~~AD3~~ W5 to produce AD3.

[[NB07-090]]
The solution to the Right Shift AD_3 seems to be to produce the DR by gating an even D_0 with ~~a delayed~~ C7 x W5 this will ensure that only the correct number of AD3s are added for each shift order where as previously the gating by C7 could have added

one to many according to whether C7 started as an odd D35 or not.
Later
The gating waveform must be W5 gated by C7 otherwise AD_3 is provided for left shift as well.

Annex Mods

Neg Coince Waveform
Majorcycle Pulse Generator
Repeat Waveform

[[NB07-091]]
Coder Rack Rewiring 0
Fuse Rewiring
Shakeproof Washers Under Diodes
Coord Control III Panel II
DC Flip Flop for TCTSU
Rewiring Operating Control
Control Desk
Number simulator SP61 Output
A link wiring for Store / Raster selection

Tests.

Patterns in Tanks 0 & 1
Termination
PAD.
ASR
Tank II.