ISR-MA/LR/rh

24th February 1971

ISR RUNNING-IN

Run 27 - 22nd February 1971

First part: 18.30 to 19.30 h

20 bunches of 22 GeV/c PS-momentum injected into Ring 1

Stacking in resonance-free region near integral Q values

Stacking experiments during run 25 had shown that the $\frac{dQ}{dp/p}$ values required for preventing "brickwall" instabilities to occur up to 3.4 A beam current were so large that it was difficult to avoid having third or fourth order resonances inside the useful aperture, when keeping the central working point in our preferred region (points ANNA, BRIT, DANE - see attached diagram).

Therefore, it was interesting to move the working point to a region much nearer Q = 9, where large $\frac{dQ}{dp/p}$ could be obtained without crossing such resonances. It was hoped that in this way larger currents could be stacked before saturation occurred.

The new working point "ELSA" was chosen at approximately $Q_H = 8.90$; $Q_V = 8.85$ and was reached by applying pure quadrupole components by means of the PFW, namely

$$\Delta Q_H^{PFW} = +0.091 \; ; \qquad \Delta Q_V^{PFW} = +0.202 \; .$$

The main magnet setting was $p_c = 22.467$ and the injection orbit was at $<\Delta r> = -31$ mm.

Measurements of Q as a function of $\Delta p/p$ during run 25 had shown the following typical values in the bare machine, in the region of $<\Delta r>$ between -33 and +37 mm (corresponding to $-1.8\ \% < \Delta p/p < 2.0\ \%$) :

	Average	|Maximum|	At central orbit
$\frac{dQ_H}{dp/p}$	-1.2	-2.8	-0.6
$\frac{dQ_V}{dp/p}$	+2.3	+3.5	+1.9

The additional Q variations produced by means of the sextupole lenses and the resulting average momentum dependences in the 5 stacking experiments covered by this report are as follows :

Stack (Figure)	$\Delta \frac{dQ_H}{dp/p}$	$\Delta \frac{dQ_V}{dp/p}$	$< \frac{dQ_H}{dp/p} >$	$< \frac{dQ_V}{dp/p} >$
1	+ 3	- .8	+ 1.8	+ 1.5
2	+ 3	0	+ 1.8	+ 2.3
3	+ 4	0	+ 2.8	+ 2.3
4	+ 4	+ 1	+ 2.8	+ 3.3
5	+ 5	+ 2	+ 3.8	+ 4.3

In making stacks 1 to 4, instabilities and sudden beam losses were observed at various current levels, as it can be seen from the figures. However, stacking could be continued and in all cases maximum currents of 3.4 A could be reached, despite the large losses produced by instability.

The sudden losses were always preceded and accompanied by the appearance of signals at the pick-up electrodes. Typical signals, observed by K. Hübner, are shown in pictures a) and b): picture c) permits to have the time scale between 2 injections (5 squares horizontal). Pictures d) and e) are the coherent oscillations observed by W. Schnell from the high-sensitivity pick-ups (through filters), during stacks 3 and 4 respectively. Picture f) shows the bunch frequency, which can be used as a scale to read that the coherent oscillations are probably 8.92 per revolution. This would point rather to a horizontal instability than to a vertical one.

It is worth noting that in stack 2 the sextupole currents were the same as during run 25 at the same momentum, when no instability had been seen at working point DANE (Q_H = .809; Q_V = .598). This would confirm that stronger $\frac{dQ}{dp/p}$'s are necessary to suppress the instability when the Q values approach an integer.

Only during stack 5 (Fig. 5), when the $\frac{dQ}{dp/p}$'s were about double than during stack 2, no instability was met. No obvious losses due to resonance were seen during stacking, but saturation occurred at 3.7 A only, probably because of the presence of several weak pulses. The working line corresponding to this condition is shown in the attached diagram.

L. Resegotti

Distribution:

ISR Parameter Committee

ISR Running-in Executive Committee

Engineers-in-Charge

Sc.staff ISR-MA

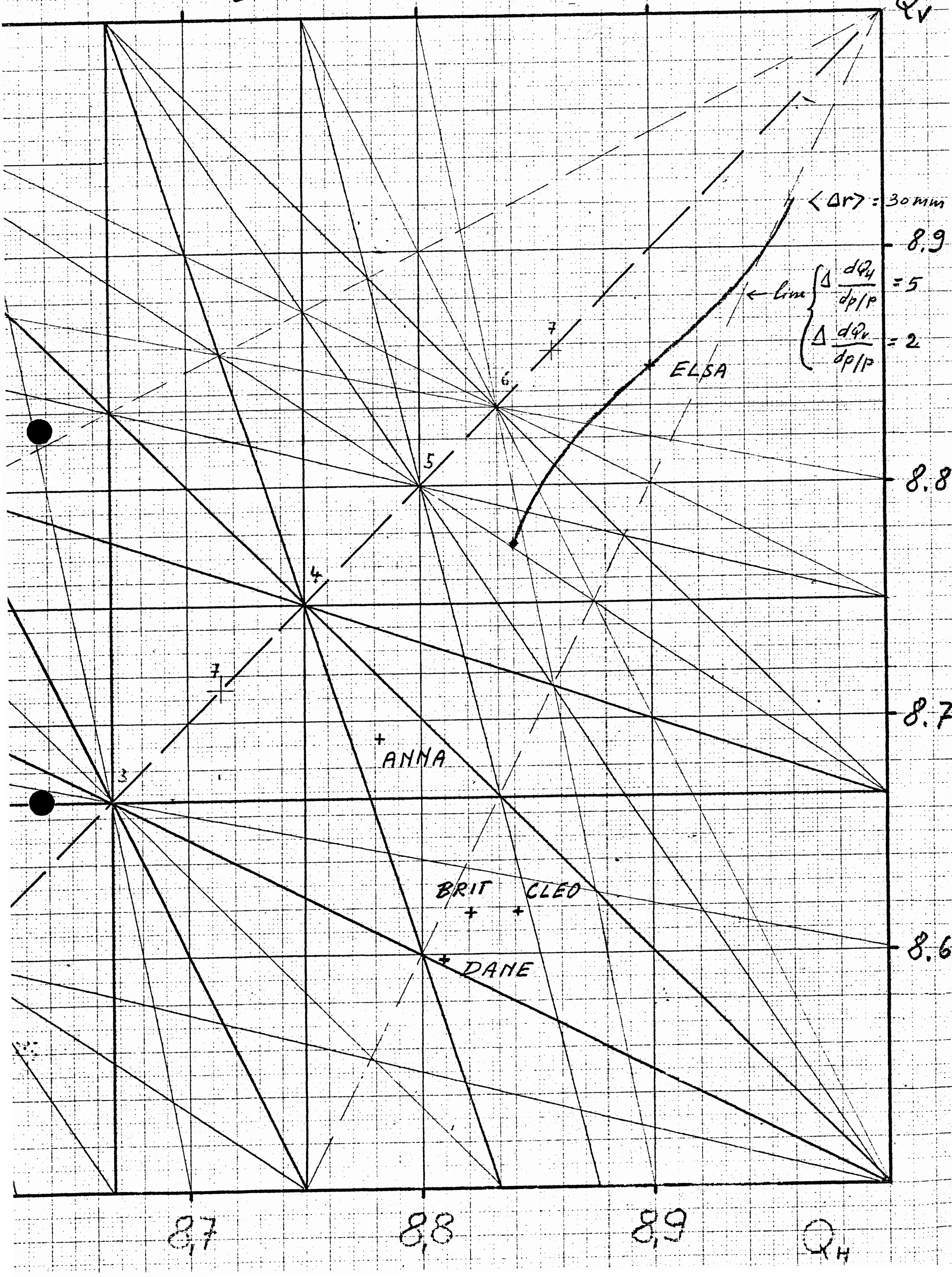
Mr. M. Höfert HP

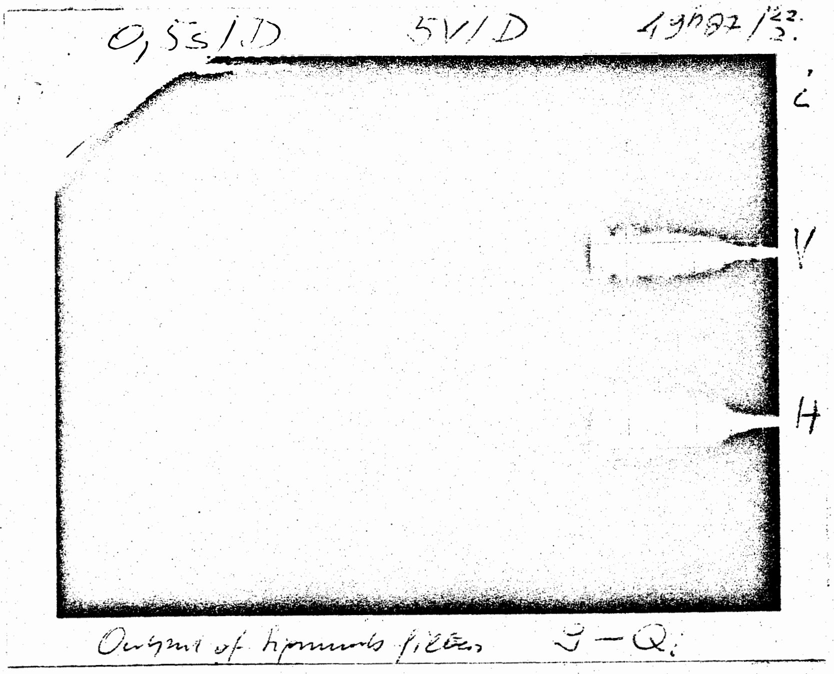
Mr. E. Brouzet MPS

WORKING POINTS IN RING 1

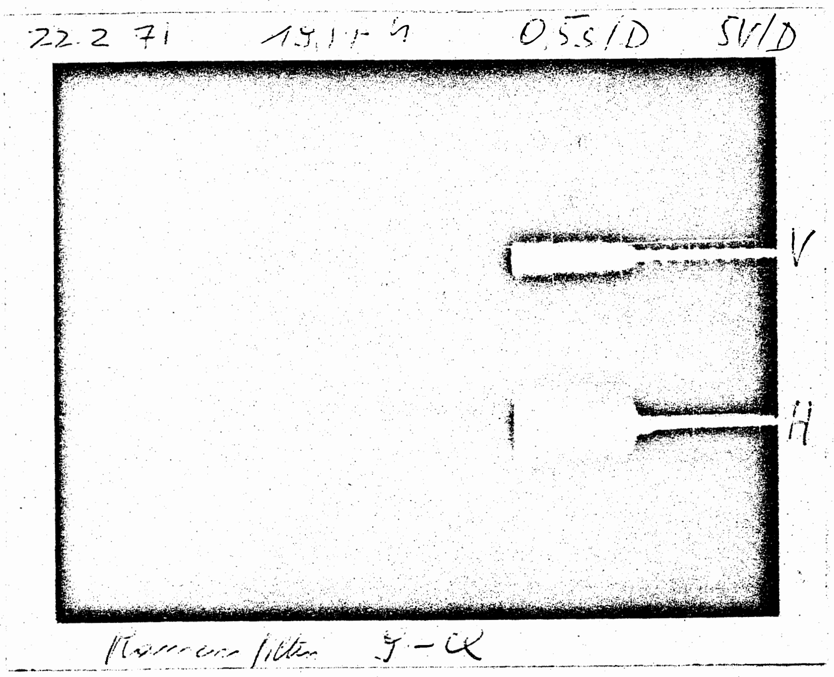
Bare Ring 1 at 15 GeV	Q_H = .822 Q_V = .656
Bare Ring 1 at 22 GeV	Q_H = .809 Q_V = .648
ANNA	Q_H = .782 Q_V = .692
BRIT	Q_H = .821 Q_V = .618
CLEO	Q_H = .831 Q_V = .618
DANE	Q_H = .809 Q_V = .598
ELSA	Q_H = .900 Q_V = .850

Ring 1 - Working points

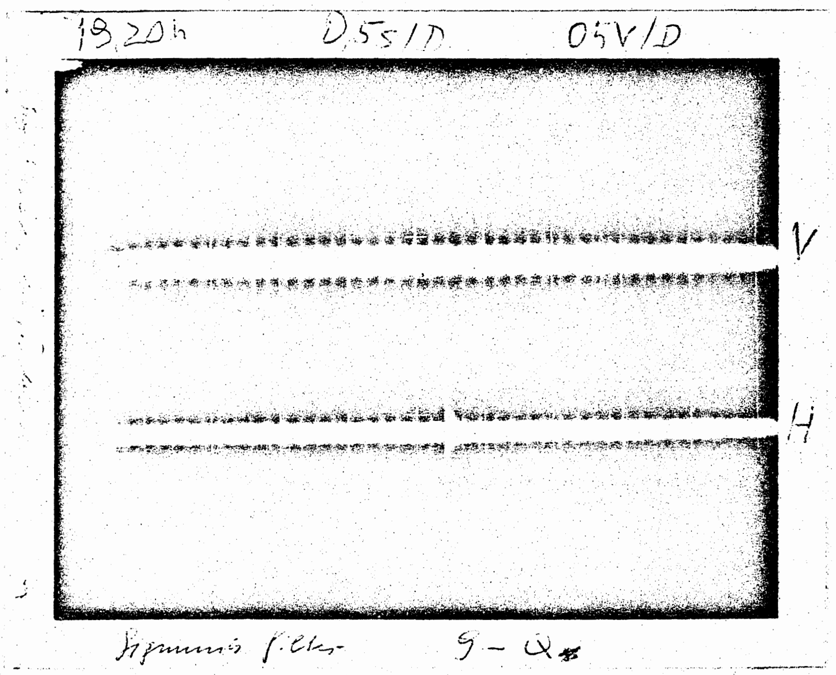




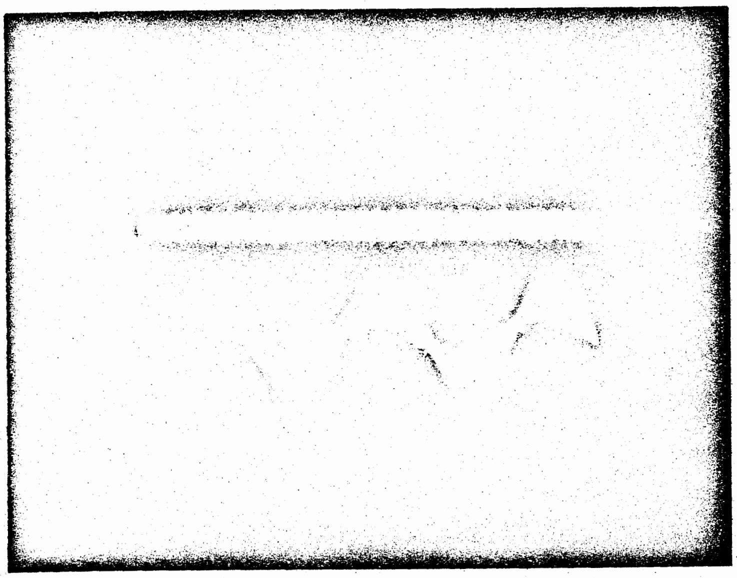
picture a)



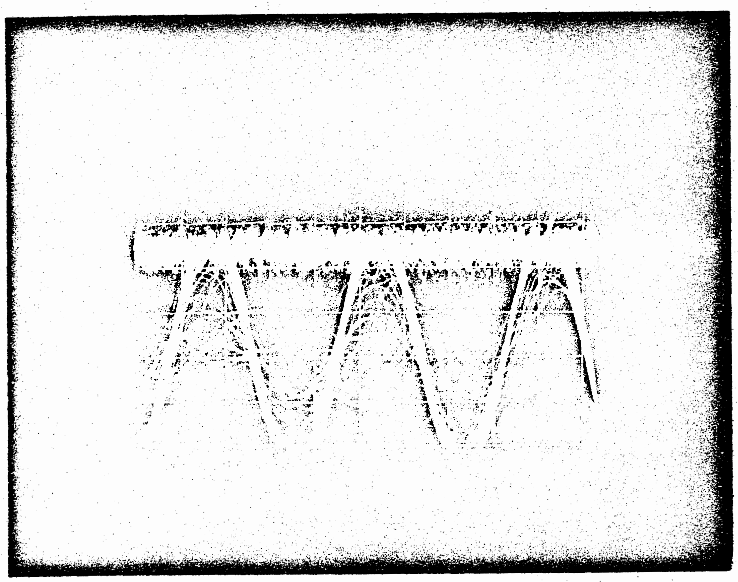
picture b)



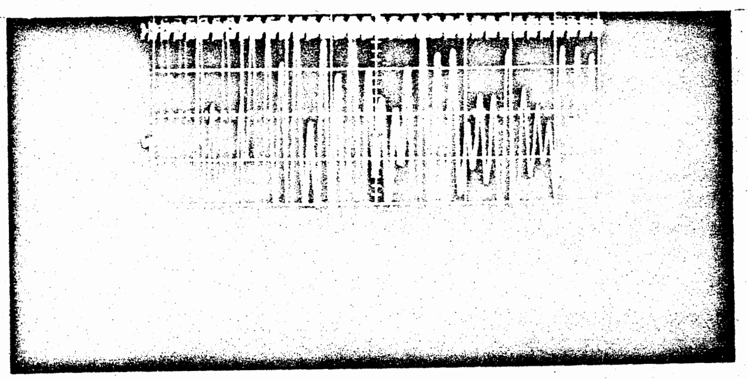
picture c)



picture d)



picture e)



picture f)

Fig. 1

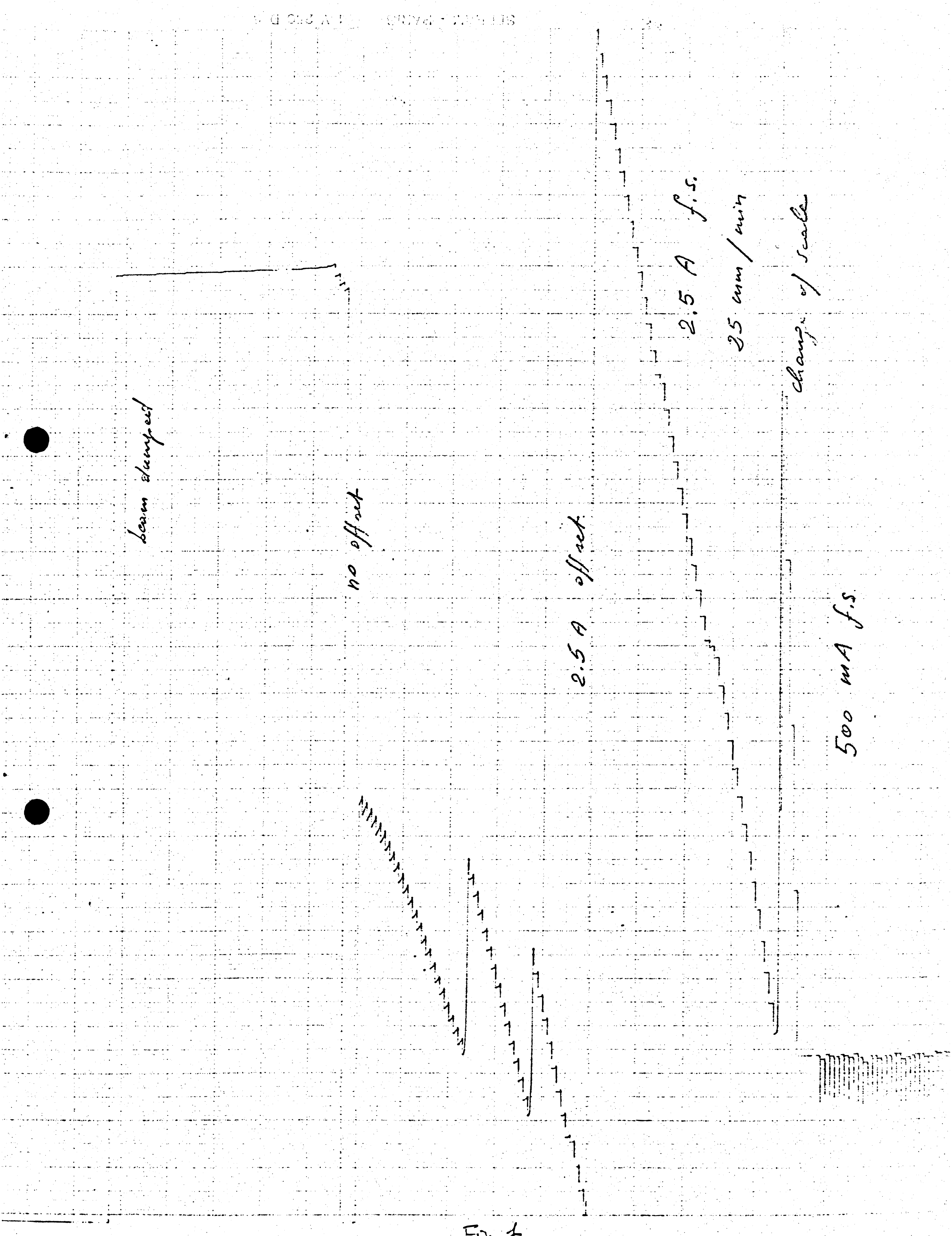

beam dumped
no offset
2.5 A offset
2.5 A f.s.
25 mm/min
change of scale
500 mA f.s.

Fig 1

Fig. 2

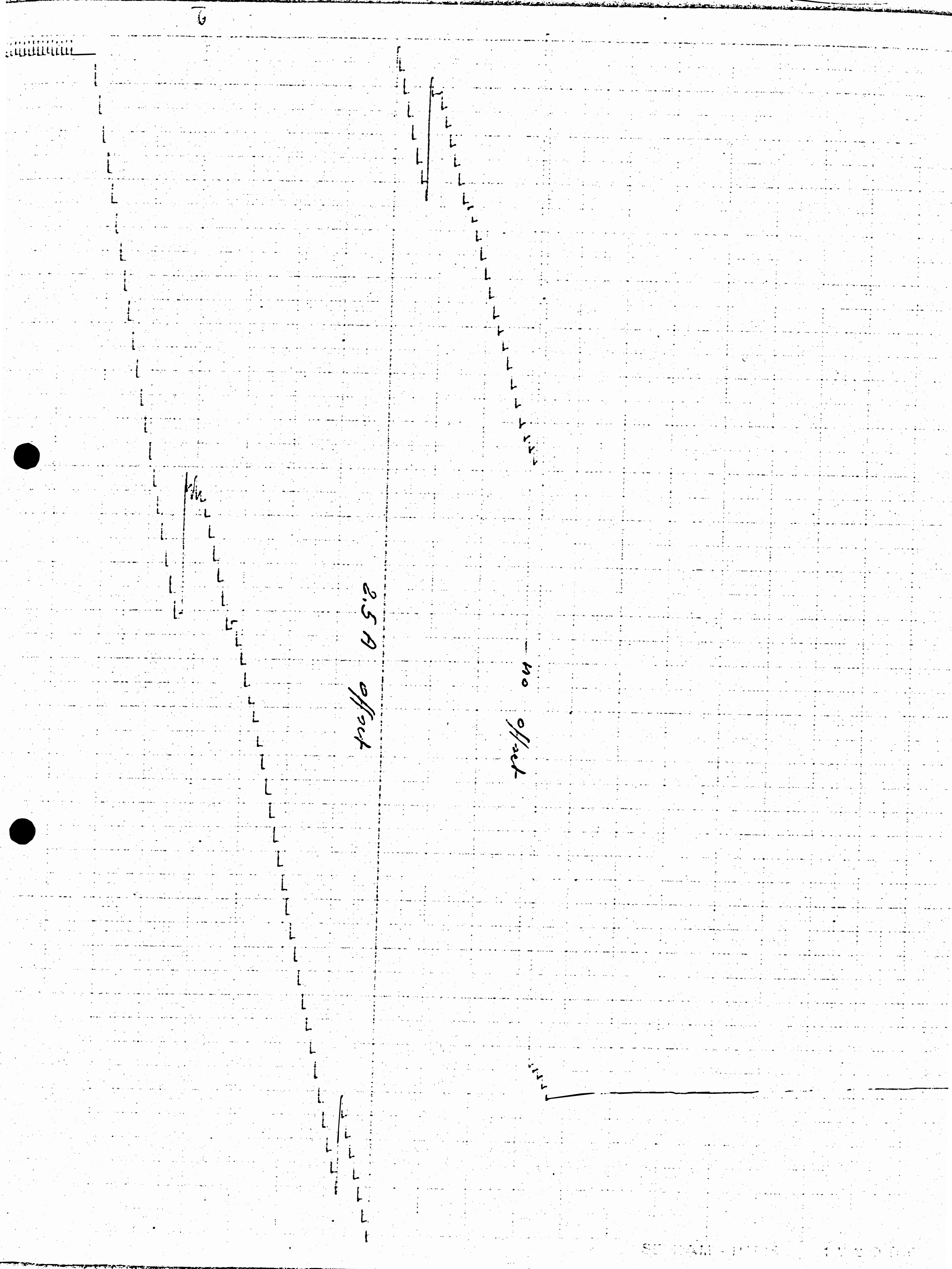


Fig. 3

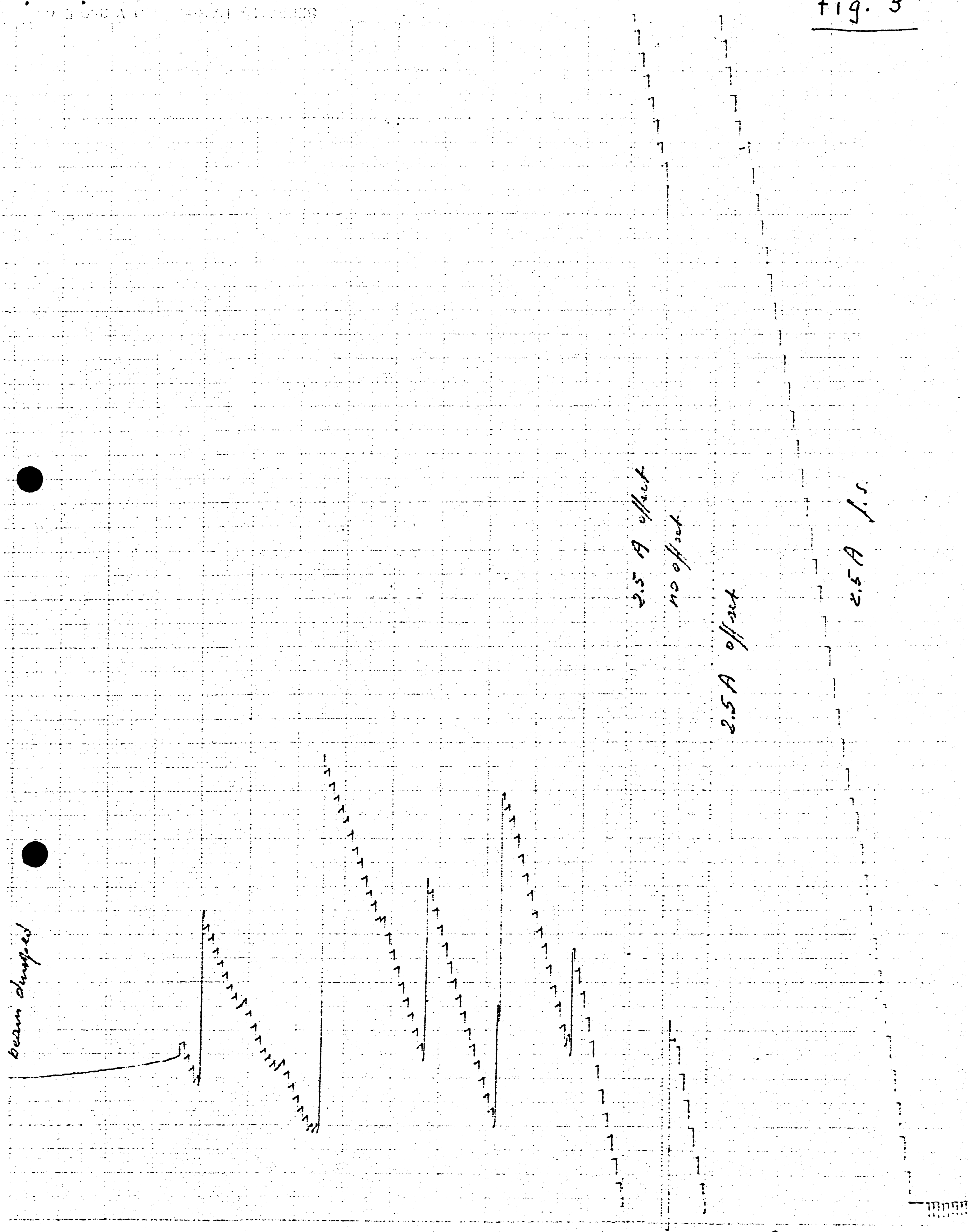


fig 3

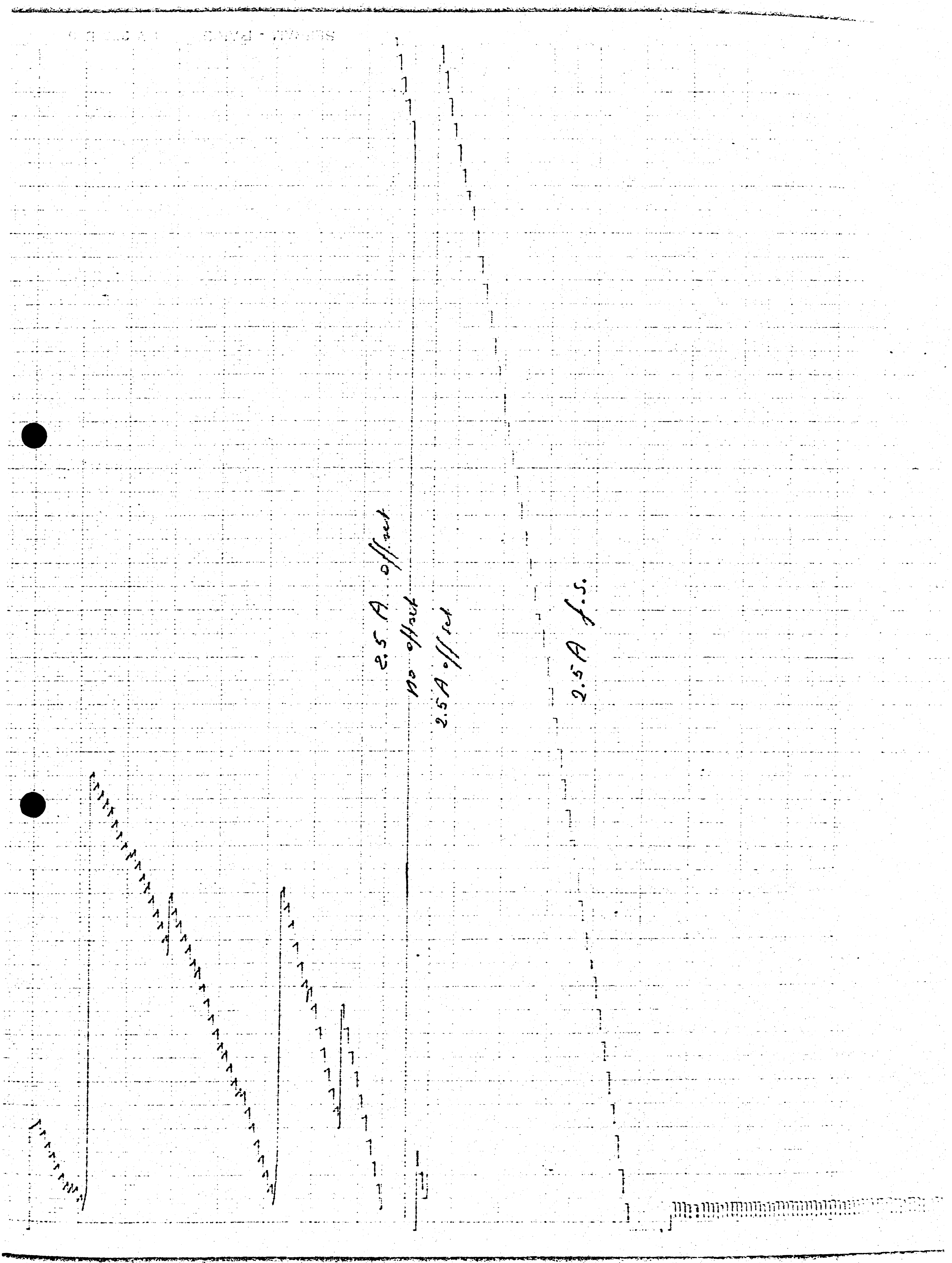


Fig. 4

Fig. 5