

Darryl Jackson.

GUIDELINES IN THE USE OF ELECTRICAL
IGNITION FOR SLASH DISPOSAL BURNS

1. INTRODUCTION
 - 1.1 Advantages
 - 1.2 Disadvantages
2. INCENDIARY MANUFACTURE
 - 2.1 Materials
 - 2.2 Construction
3. AUXILIARY EQUIPMENT
 - 3.1 Connecting wire
 - 3.2 Circuit tester
 - 3.3 Blasting machine
4. CIRCUITS
 - 4.1 Circuit size
 - 4.2 Circuit design
 - 4.3 Circuit layout
 - 4.4 Splicing in incendiaries
 - 4.5 Production rates
5. SAFETY
 - 5.1 Blasting powder
 - 5.2 aluminium dust
 - 5.3 Transportation
 - 5.4 Laying circuit
6. ELECTRICAL IGNITION PLANNING CHECKLIST
 - 6.1 Read
 - 6.2 Survey
 - 6.3 Circuit design
 - 6.4 Resistances
 - 6.5 Materials
 - 6.6 Ampower
 - 6.7 Timing
 - 6.8 Contingency
7. AN EXAMPLE

GUIDELINES IN THE USE OF ELECTRIC IGNITION FOR SLASH DISPOSAL BURNS

1 INTRODUCTION

Electrical ignition of logging slash involves the use of incendiaries pre-laid in circuits over the burn area and capable of being detonated remotely by means of an electric current.

The circuits can be fired in sequence as would occur in strip burning or simultaneously to give area ignition.

1.1 Advantages - The advantages of electrical ignition are:

1.1.1 Safety - It eliminates the need for men to be walking through a hazardous environment with the added danger of a severe if not fatal burn should they be incapacitated by a fall.

1.1.2 Night burning - It allows burning at night when conventional lighting methods could be dangerous or time consuming.

1.1.3 Reduction of lighting time - It allows for virtual instantaneous ignition with the associated advantages of a more intense fire.

1.1.4 Manpower - It frees manpower from lighting duties making them available for suppression work.

1.2 Disadvantages - Electrical ignition is not without its disadvantages however, the principal being:

1.2.1 Reduction in flexibility - once the circuits are laid the controller is committed to a particular firing pattern unless he resorts to Manual ignition.

1.2.2 Damage - Circuits are subject to damage by animals, people or falling material, consequently require constant checking and possible time consuming repair.

Electrical ignition can be used in any burning situation, however it is best used where its advantages as outlined above offer real gains over the disadvantages.

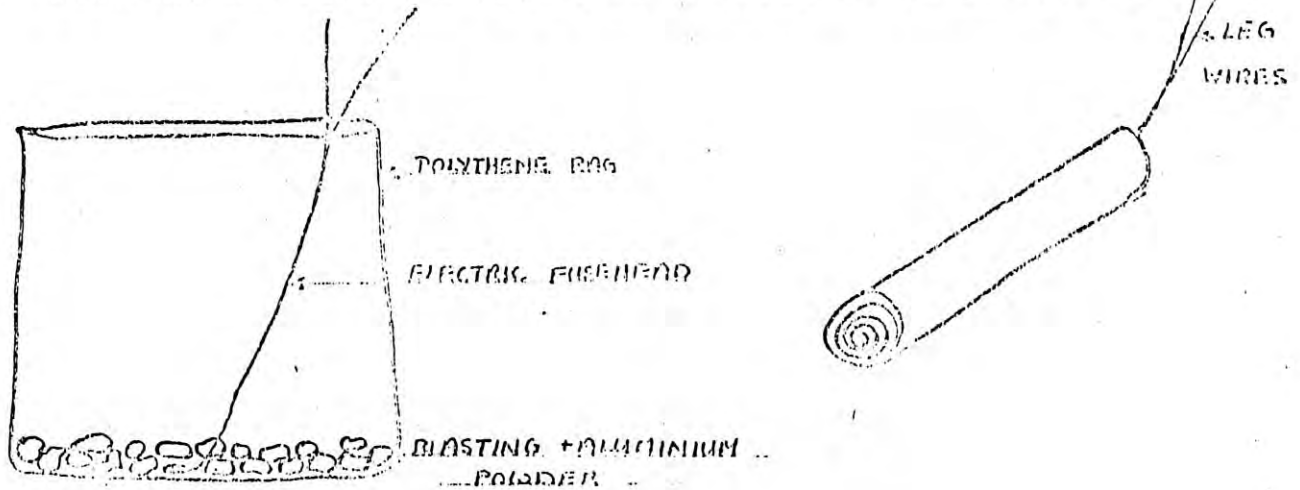
2 INCENDIARY MANUFACTURE

2.1 The materials needed for the manufacture of an incendiary are:

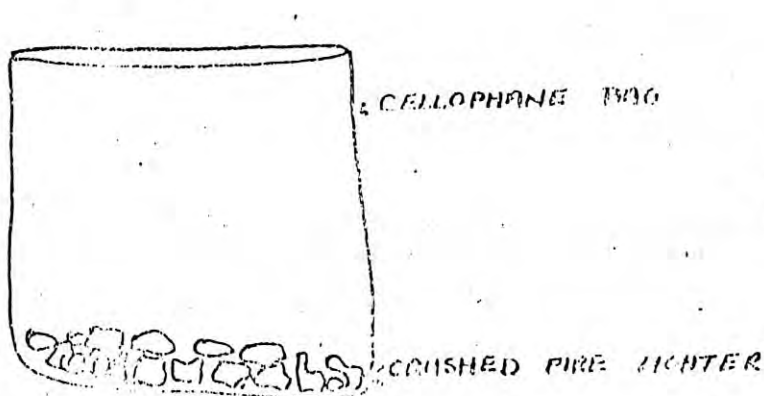
Quantity	Material
2	Polythene bags 150mm x 100mm
1	Cellophane bag 150mm x 100mm
1	Electric fusehead
15 gms	Blasting powder
1 gm	Aluminium powder (coarse grained)
1/40 of a	Commercial fire lighter (BARBA-LITE)
standard pack	Cellophane
0.3m	

2.2 Construction entails:

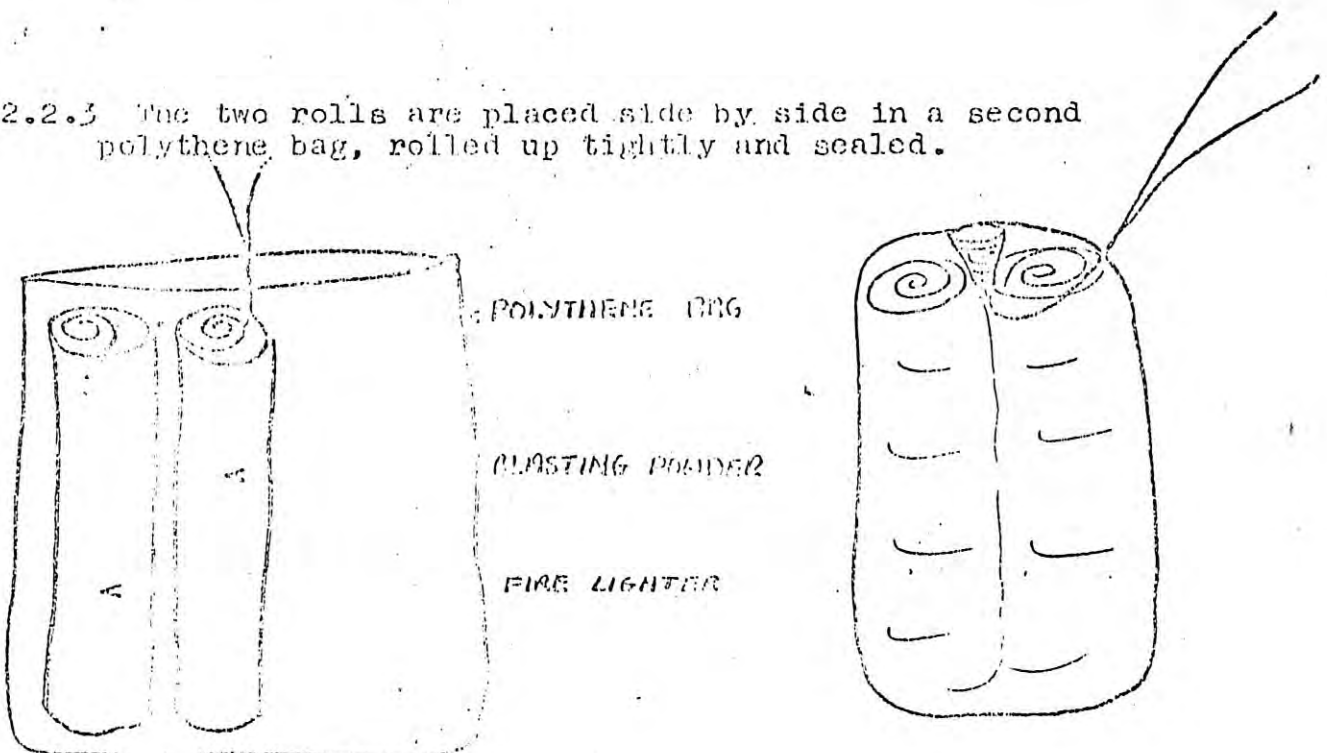
- 2.2.1 Weigh into a polythene bag 10gms of blasting powder and 1 gm of coarse grained aluminium powder. Mix thoroughly and insert an electric fuschend ensuring it is centrally placed in the powder. Roll the bag into a cigar shape and fasten with cello tape after ensuring the fuschend leg wires protrude at least 150mm.



- 2.2.2 A portion of fire lighter equivalent to one fortieth of the standard commercial pack is crushed and placed into a cellophane bag. The bag is then rolled into a cigar shape.



- 2.2.3 The two rolls are placed side by side in a second polythene bag, rolled up tightly and sealed.



3 AUXILIARY EQUIPMENT

To lay out and successfully fire a circuit the following equipment is required:

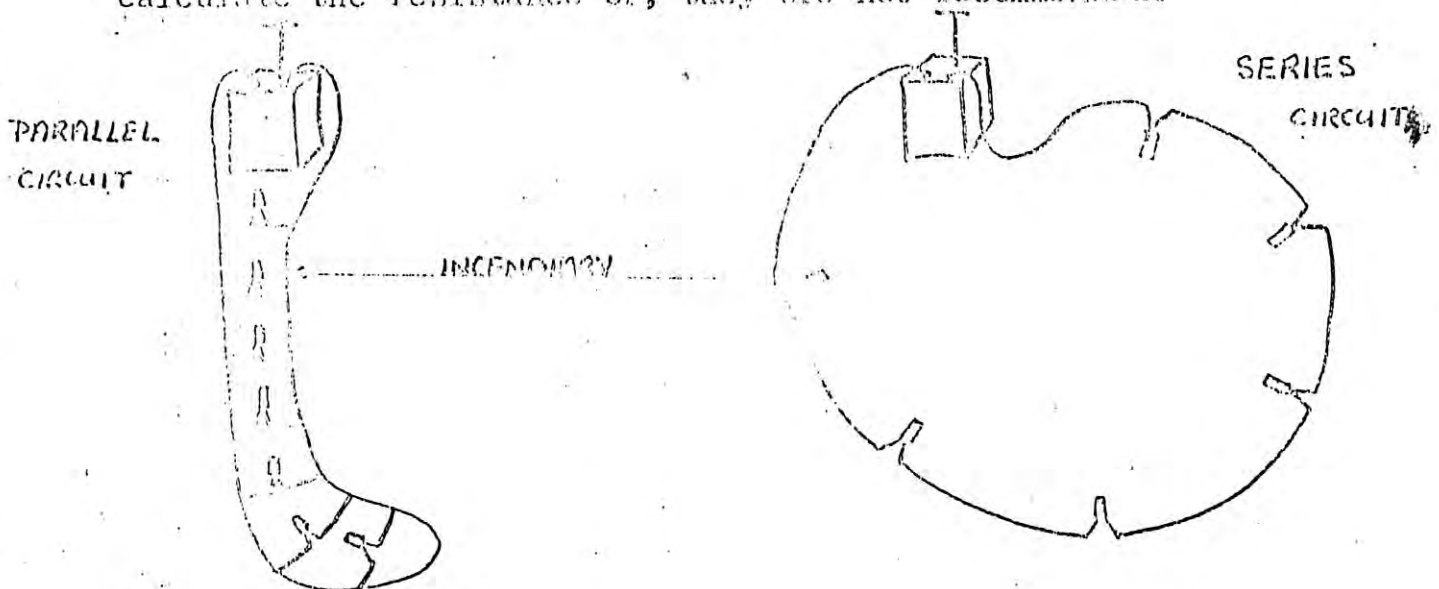
- 3.1 Connecting wire - Used to lay the circuit into which the incendiaries are placed. The recommended type is BSWG No. 25 plastic coated copper wire. It is available in reels of 1000 metres from I.C.I.
- 3.2 Circuit tester - This is required to check the continuity of the circuit before firing is attempted. A suitable type is the Nobel BLAST-O-METER which measures circuit resistance by a current small enough to ensure fuseheads are not detonated.
- 3.3 Blasting machine - This is required to detonate the incendiaries in the circuit. There are two types readily available at present. These are:
 - 3.3.1 Beethoven Dynamo Condenser - a capacitor type machine combining high potential with portability. It is capable of overcoming a resistance of 720 ohms in a series circuit whilst delivering the required 2 amps current.
 - 3.3.2 "50 Shot" Exploder - a rack bar type machine capable of overcoming a resistance of 200 ohms in a series circuit. The full potential of this machine is only realized if the handle is depressed as rapidly as possible.

4 CIRCUITS

There are two basic types of circuits, series and parallel, with combinations between them also possible.

Series circuits will accomplish everything required in slash burning and are simple to lay out and calculate the resistance of.

Parallel circuits offer no real advantages over the series type and as they use more wire, are harder to lay out and calculate the resistance of, they are not recommended.



4.1 Circuit size

The size of a circuit, i.e. its total resistance will depend on the length of wire and the number of incendiaries in the circuit.

It is important that total resistance does not exceed the capabilities of the blasting machine to be used, i.e. 720 ohms for the Beethoven and 200 ohms for the "30 Shot" machine.

Detailed below is the maximum combinations of wire and incendiaries that can be successfully fired in a series circuit using either of the blasting machines.

Length of circuit (metres)	Maximum No. of incendiaries	
	"Beethoven"	"30 Shot"
0	360	100
250	350	90
500	340	80
750	330	70
1000	320	60
1500	300	40
2000	280	20
3000	240	0
4000	200	0
6000	120	0
9000	0	0

This is based on a resistance of 2 ohms per fusehead and 8 ohms/100 metres of BSNC No. 25 copper wire.

Individual resistances in a series circuit are added to calculate total circuit resistance.

4.2 Circuit design

An essential prerequisite to circuit design is a map of the burn. A pace and compass survey is fast and of sufficient accuracy.

An oblique aerial photo is ideal for this because it shows internal snig track layout. The calculation of distances can be difficult on these photos, however accuracy is not paramount for circuit planning.

4.2.1 Strip width and incendiary spacing.

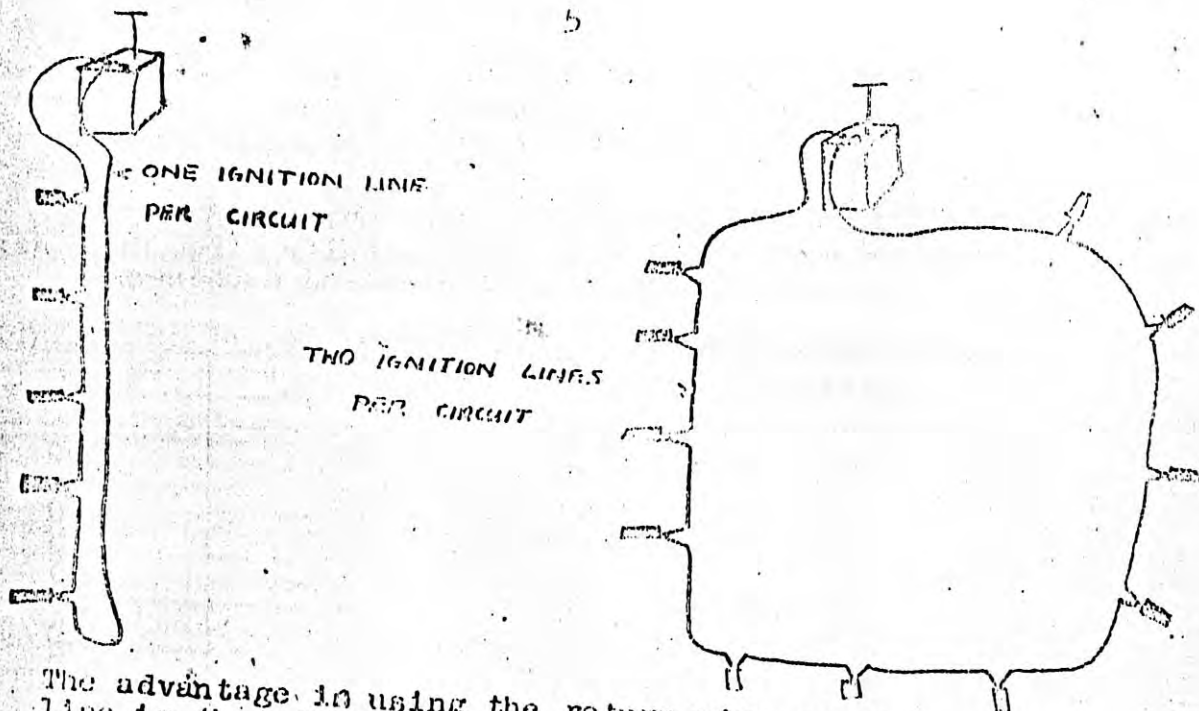
Experience has shown that for dry fuels a spacing of 75 x 25 metres is effective. Successful results have been accomplished at 100 x 50 metres however fire build up is slower.

When fine fuels are towards the damp end of the scale (18%) spacing should be closed in to achieve satisfactory intensity.

4.3 Circuit layout.

When considering the circuit layout the planner must be aware of the limitations of total resistance, i.e. length of circuit (refer to 4.1) and the number of strips he desires to ignite with one circuit.

4.3.1 In many cases the length of the initial run will determine the number of strips possible in one circuit. There will however, always be a choice between one or two lines of ignition on a circuit, e.g.



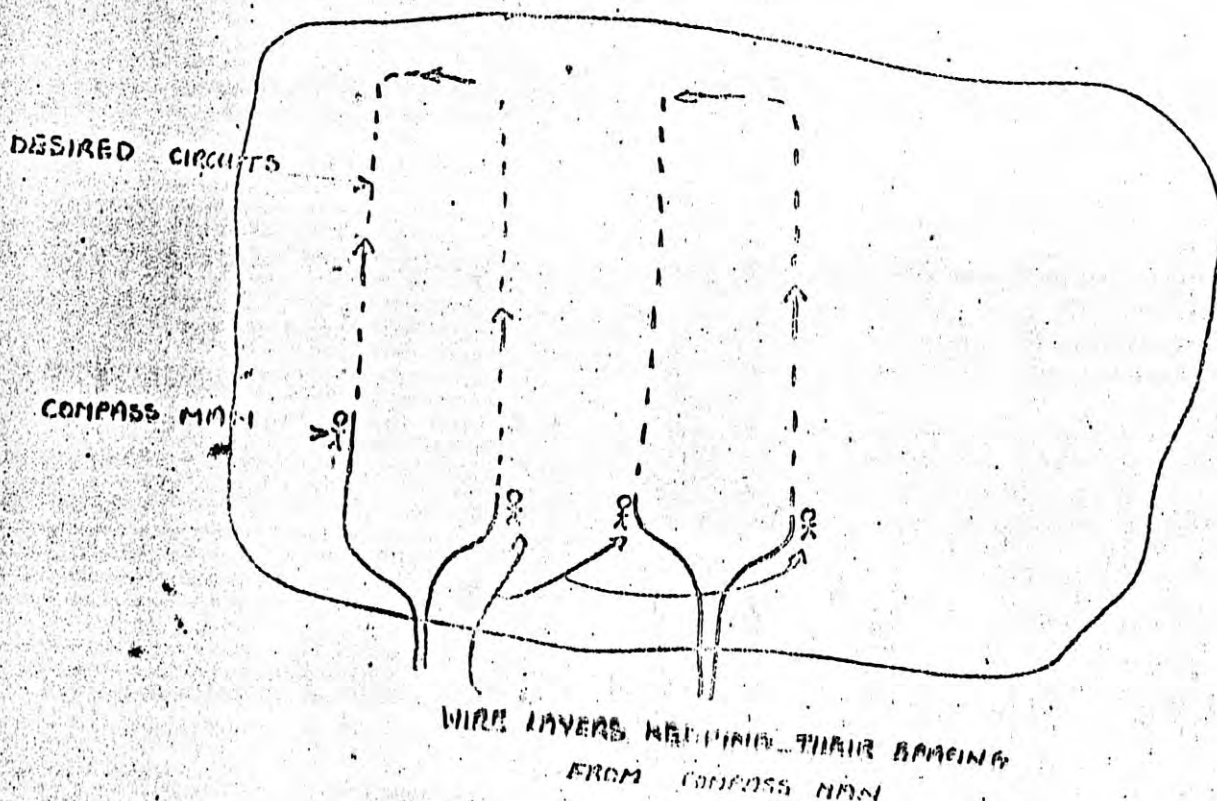
The advantage in using the return wire as an ignition line is that the amount of wire required for the burn is virtually halved. Its disadvantage is that if strip burning is being employed the lighter is committed to the ignition of two lines at once which may result in more area alight than the conditions warrant.

It is usually unnecessary to have more than two strips per circuit. This is because single loop circuits are easier to lay out, check and repair than multiloop circuits. In addition the delay between firing two circuits when their leads are at the same point is insignificant for instantaneous ignition.

4.3.2 The physical process of laying the wire in the field according to the plan can be difficult because slash areas are generally formless and difficult to walk through.

So that lines are laid parallel to each other at the correct spacing either all wire layers can be equipped with a compass or a leader is, and others take their spacing from him whilst moving line abreast.

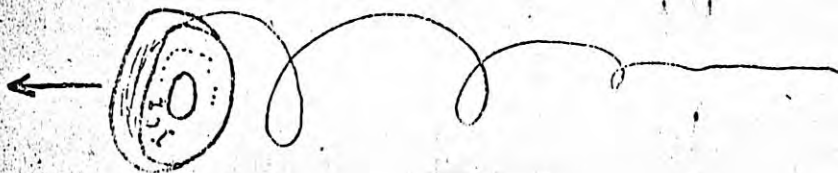
E.G.



when wire is being laid it is important that three points be observed:

- (i) Allow plenty of slack so that tension breaks are eliminated and the wire may be moved to advantageous points when incendiaries are connected. This should amount to approximately 20% of the straight line distance.
- (ii) Do not stick religiously to a straight path. Deviate within reason to heavy fuel accumulations.
- (iii) Cross bare areas with a minimum of wire as this is where breaks due to kangaroos etc. occur.

4.3.3. Although back pack wire layers have been tried, it has been found that the most effective way of wire laying is by carrying a spool and feeding it off such.



In this way the reel can be taken more easily under logs, through slash heaps etc.

4.3.4 Circuits are subject to breaks from animals etc. consequently it is desirable that they be put in as close to the burning date as possible.

A good system to use is to lay out the connecting wire some time before the burn, then connect the incendiaries either the day before or on the morning of the burn.

4.4 Splicing incendiaries into the main line involves three steps:

- cutting the main line.
- stripping the plastic
- connecting the incendiary

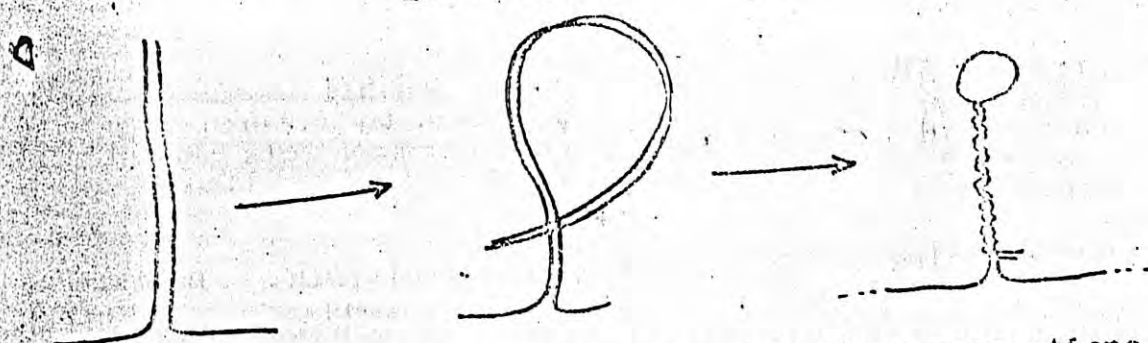
Despite the availability of combination wire strippers and cutters, experience has shown the most efficient device to accomplish the first two steps is a penknife. Care must be taken when using a blade to strip the plastic from the wire, that the operator does not use a cutting action which can break or weaken the wire.

4.4.1 Connecting incendiaries into the main wire is a critical phase of the operation because the quality of the splice will determine the physical strength of the circuit and its conductivity.

Of all the types of splices used the best is the "loop splice".

This consists of placing the wires side by side, bending the ends back to form a loop and twisting the loop.

LOOP SPLICE



It is not necessary to insulate joins but connections should be well separated to avoid short circuits.

- 4.5 Production rates for laying wire and splicing incendiaries will vary according to the topography and fuel. The figures below then, represent an average situation based on the experience of four field trials.

Production in one man hour

Wire laid (metres)	No. incendiaries spliced/hr		Distance travelled splicing (m)	
	x25m spacing	x50m spacing	x 25m	x 50m
300	30	16	750	800

This indicates that spacing between incendiaries makes little difference to production rates as most time is spent in walking between ignition points.

- 4.6 Testing of the circuit can be done using the Nobel BLAST-O-METER.

If no reading can be obtained it means the circuit is dead and will require repairing.

Repair is accomplished by first joining the firing ends together then following the line back with the circuit tester checking connections.

When a break is found the two exposed wires are used to check the circuit at that point. If a reading is obtained the position of testing is the only break in the circuit. If no reading can be obtained there is a further break in the circuit which will have to be found and the process repeated until the circuit is closed.

5 SAFETY

Operators find the use of this ignition technique brings them into contact with new safety hazards as well as old. In all cases common sense coupled with safety awareness should be an adequate safeguard. Nevertheless it does not hurt to be reminded of likely trouble spots and possible preventative measures.

- 5.1 Blasting powder is used in the manufacture of incendiaries and although it will not explode unless trapped in a confined space, will burn fiercely and rapidly when ignited. It should be stored in a magazine when not in use and kept away from heat sources during use.

- 5.2 Aluminium dust also used in the manufacture of the incendiaries may be a mild skin irritant to some personnel and can be slightly toxic when inhaled and moderately explosive when exposed to flame.

When using the dust it is recommended that the operator work in a well ventilated environment wearing normal skin protection and using a dust mask.

5.3 Transportation of the incendiaries from the office to the field should be done in a wooden box with tin lining. This eliminates the possibility of them being ignited by a spark at the fire or minimizes any damage if they do ignite.

5.4 Circuit layout involves scrambling over tops, logs etc. as a consequence the possibility of a fall is reasonably high. The fall and its effects can however be guarded against by a few simple measures.

5.4.1 Use operators in pairs or at least where they are able to keep a constant check on each other.

5.4.2 Use logging spurs to ensure a firm foothold on logs.

5.4.3 Select the fittest men for the job.

6 ELECTRICAL IGNITION PLANNING CHECKLIST

6.1 NEED

Has the area been surveyed to ascertain the need for electrical ignition in place of manual lighting?

6.2 SURVEY

Has a map or aerial photo been prepared to aid planning?

6.3 CIRCUIT DESIGN

1. What lighting pattern is desired?
2. What size and shape circuits will be required?
3. What is the best incendiary spacing?

6.4 RESISTANCES

Is the resistance of each circuit within the limitations of the exploder potential?

6.5 MATERIALS

1. Do I have enough wire and incendiaries for the job?
2. If not, can these be ordered in time?

6.6 MANPOWER

1. How many men should/could do the job?
2. Will they require training?

6.7 TIMING

1. How long should set-up take?
2. Can it be done immediately prior to the burn to avoid risk of damage?
3. If not, when is the best time?

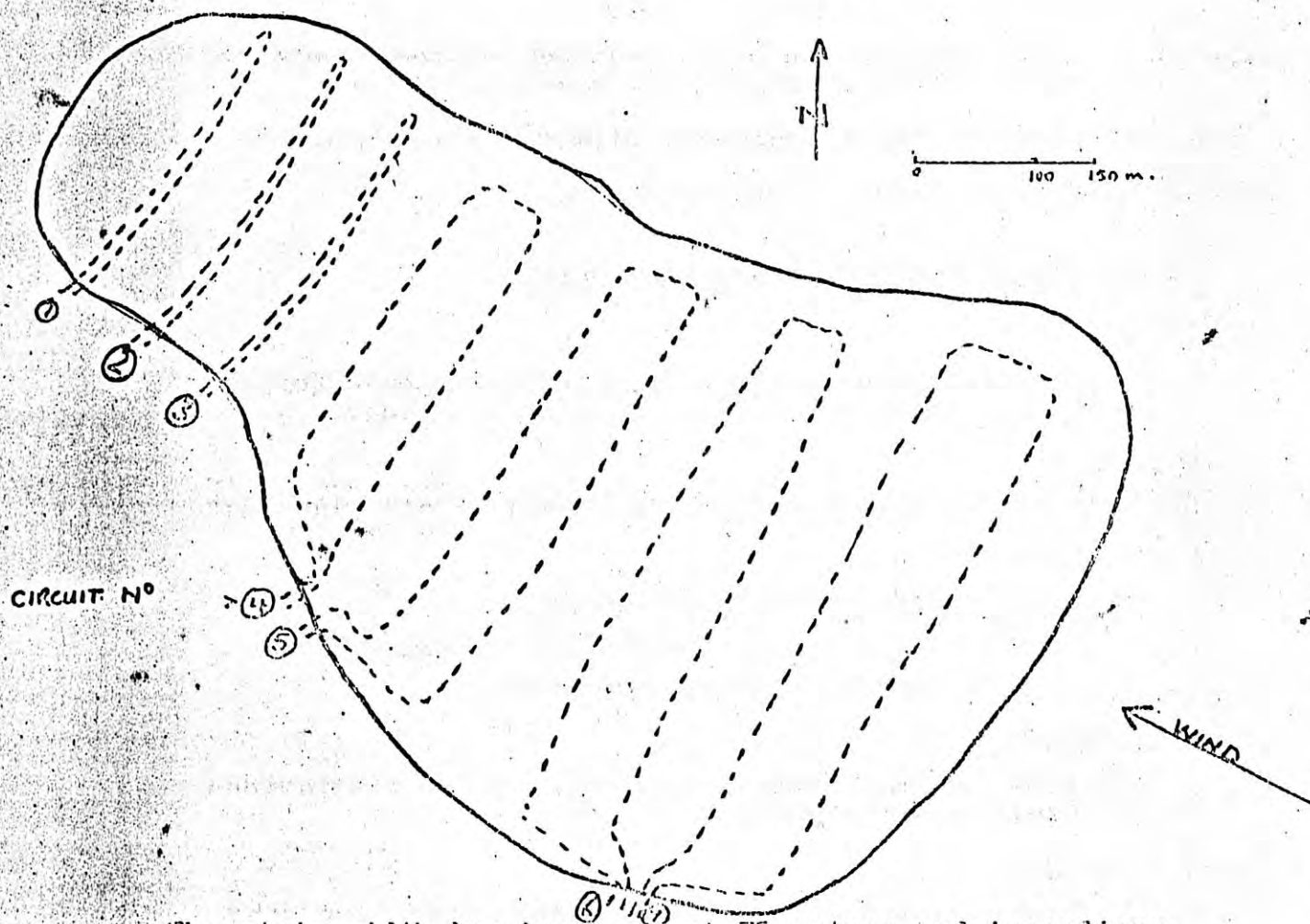
6.8 CONTINGENCY

Has an alternative plan been prepared should firing fail.

AN EXAMPLE

An area of 40 ha designated coupe E1 has been selected for electrical ignition because of the heavy nature of the fuel and the absence of snig tracks which would make manual lighting hazardous.

- 7.1 The controller has decided to use the strip firing technique into a south easterly wind. A pace and compass survey of the area has produced the plan below, on which the controller has drawn in the circuit design.



The strip width has been set at 75 metres and incendiary spacing at 25 metres.

Circuits 1, 2 and 3 have been designed as lines of ignition to be fired in sequence to gradually extend the fire into the burn. Once these have become established circuits 4, 5, 6 and 7 will be fired rapidly to achieve a mass fire and inlow winds. Hand firing of the edges will follow circuit firing.

- 7.2 To estimate the amount of materials needed the controller has calculated the lengths of each circuit allowing an extra 20% for slack.

He has then estimated the number of incendiaries required at the 25 m spacing and checked to ensure this would not exceed the potential of the "Beethoven"

Circuit No.	Circuit length (m)	No of incendiaries required
1	575	11
2	575	11
3	650	13
4	1050	42
5	1250	50
6	1450	58
7	1650	66
Total	7200	251

From this it can be seen that to complete the job 8 reels of wire and 251 incendiaries will be required. All circuits are well within the range of the Beethoven and circuits 1 to 4 are within the capabilities of the 30 shot machine.

7.3 Setting up the Burn.

With four men available the procedure used was that two men would lay the wire and the other two would follow up connecting the incendiaries.

Doing each circuit separately and starting at circuit 7 the time sequence based on the production rates in section 4.5 was

Circuit No.	Circuit length (m)	Time
7	1650	0900-1000
6	1450	1015-1115
5	1250	1130-1215
4	1050	1315-1350
3	650	1400-1445
2	575	
1	575	1445-1515

Circuits 2 and 3 were done simultaneously as they required only two men each. Circuit 1 was done with three men, two laying the wire and one connecting the incendiaries.

Total preparation time was 21 man hours. By the time preparation was completed (1515 hrs) it may have been too late to start the burn. With eight men used in the preparation however, setup time could have been halved and the burn ready to light at 1130. This would give plenty of time to complete the burn that day.