ELECTRIC FENCING

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SECOND REVISED EDITION
1968

Special Publication No. 7 of the
TUSSOCK GRASSLANDS AND MOUNTAIN LANDS INSTITUTE

FOREWORD

The first edition of this booklet was published in 1963. It met a ready demand and has been out of stock since 1964.

Mr Weston has now brought the materials, prices, and techniques up-to-date. Mr Hughes has redrawn some illustrations and added others.

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Printed by Simpson & Williams Ltd.

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INTRODUCTION

Since 1958, when details of electrified permanent fencing tried by Massey College became known, hundreds of miles of electric subdivision fence have been erected. The key to its popularity has been the great saving in costs of materials, transport and labour. It is also easier to erect, so can be built by farm labour instead of waiting for contract fencers. This reduces the cost still further.

The success of electric fencing depends on

(a) Careful insulation of electrified wires.

(b) A continuous earth wire running the length of the fence and connected to the earth terminal of the electric fence unit.

(c) Removal of stray wires and excessive green vegetation from the fencelines.

In practice, thistles, grass, clover, secondary growth and tussocks gradually reach the live wires and reduce the efficiency of the fence, particularly in wet or misty weather. Sometimes insulators slip, break or become coated with dirt, so that again electric leakage becomes serious.

Furthermore the "wind-charger" units available for inaccessible places sometimes fail to keep the battery fully charged. Consequently a number of electric fences have become ineffective. **On the other hand where a "mains" operated unit has been used, and the fence checked regularly, electric subdivision fences have been very effective.** In fact, once the stock learn to respect an electric fence over a period of months, there is no need to worry if it happens to be off for some days.

Nevertheless, there are some ineffective electric fences, so many people hesitate to regard them as permanent, and suggest that they should be reinforced or replaced by standard fences when finance becomes available.

This makes it clear that there are definite requirements to be met, and limits to its use as permanent fencing.

THE PLACE OF PERMANENT ELECTRIC FENCING

Here are the conditions necessary for an effective fence:

★ The most important factor is that it should give the sheep and cattle a shock strong enough to repel them. This will depend mainly upon the insulation but also upon how good the electric fence controller is.

★ Second, the fence must be able to stand up to chance charging by stock (particularly at gateways), hungry cattle pushing each other against it, stock rubbing, or perhaps wild animals such as deer, pigs and goats.

★ Third, the fence must suit the country so may have to be built to avoid or withstand slips, bogs, erosion, snow drifts, rolling stones and high winds.

If an electric fence can meet these requirements at a substantially lower price than for ordinary fencing, there is a place for it. The costs and labour of buying, carting, and laying on the site as well as the actual fence construction must be taken into account.

Runholders may find that traditional standard-and-wire fences on mountainous country cost little more to erect and are easier to maintain. **However, where cattle cause damage, it may be worth fitting a top electric wire instead of the usual barbed wire.** This system is common for the "bull paddock."

In any case it appears that some electric fence parts may fail under the extreme conditions at over 3,000 feet. Furthermore, it is doubtful whether a battery unit can be relied on to function satisfactorily in remote regions for three months or more as is often suggested. The new mains-power units offer scope for five miles of electric fences in more accessible country.

JOBS ELECTRIC FENCING CAN DO

(a) **Break fencing for feeding-off crops or grass.**

(b) **Temporary fencing for 12 months or so.**

(i) For protecting shelter belts.

(ii) Temporary subdivision for different crops.

(iii) Temporary fencing until permanent fencing can be built.

(c) **Semi-permanent fencing for five to ten years.**

(i) Subdivision of cropping paddocks when in permanent pasture, for better stock management.

(ii) To defer permanent fencing until finance is available.

(d) **Permanent fencing**

for (i) Subdivision fencing on flat country.

(ii) Subdivision of rolling country and improved hill country. (Avoid slip faces.)

(iii) Subdivision through secondary growth.

A track must be cleared wide enough so stock don't bump against the fence when walking along the fence line.

(iv) Tussock country subdivision.

Great care must be taking in siting the fenceline. Normal standard and wire fencing is best for fences:—

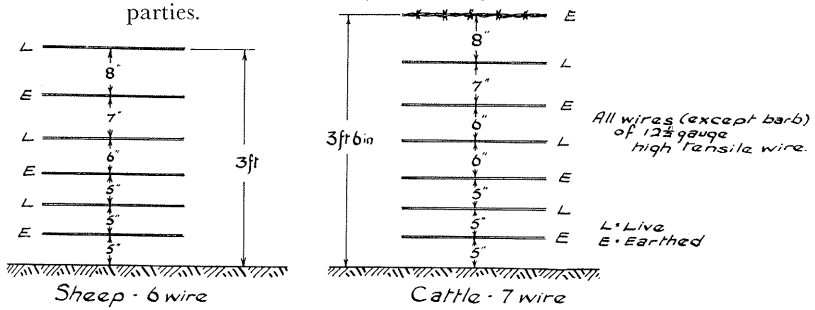
—over 3,000 feet.

—on very wet slopes

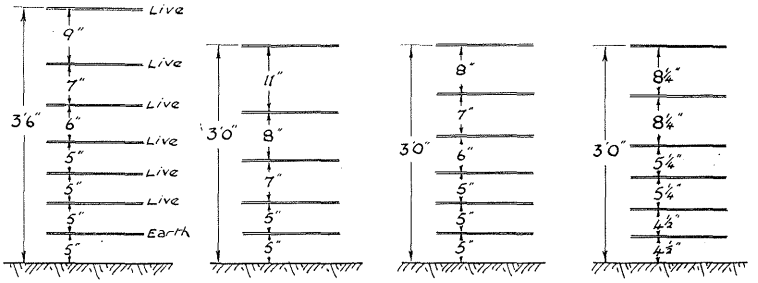
—on very rugged, undulating country when the line can't be bulldozed

—where the fence is rarely seen.

(v) Boundary fences subject to agreement between interested parties.



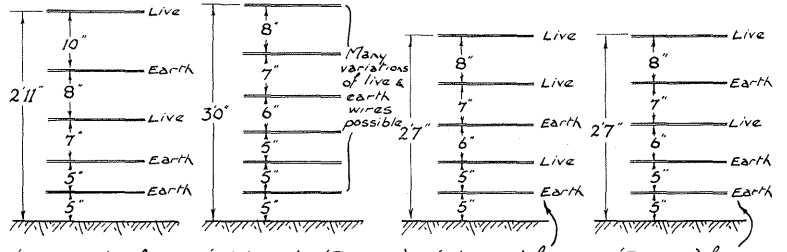
RECOMMENDED TYPES OF ELECTRIC FENCE



'Arcrite' 7 wire | 'Allways' or 'Barrier' 5 wire | 'Speedrite' 6 wire | 'Barrier' 6 wire

Note: Normally only bottom wire is earthed but if high plant cover to be tolerated, this can be done to bottom two wires by isolating bottom wire on chain assembly with an insulator

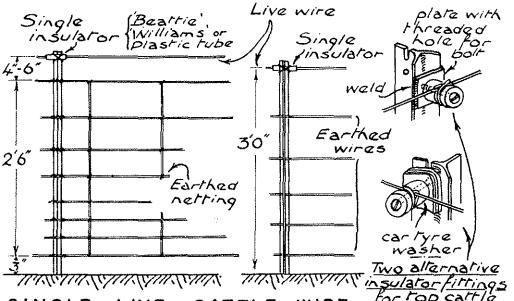
BRACKET ASSEMBLIES



'Beattie' - for English 'Y' or 5/16 flat standard. 5 wire | 'Williams' or 'Beattie' - for 'Waratah' standard. 6 wire | 'Williams' - for top 5 holes of 'Waratah' | 'Beattie' for top 5 holes of 'Waratah'

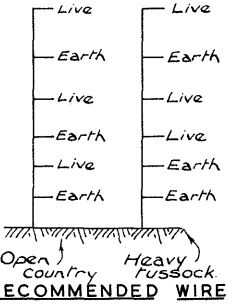
SINGLE INSULATORS

MANUFACTURERS RECOMMENDATIONS FOR SPACING WIRES



SINGLE LIVE CATTLE WIRE over earthed netting or wire fence.

NOTE: When using single insulators fixed to wooden posts, wires must be free of wood & earth wires grounded every two or three posts.



RECOMMENDED WIRE PATTERN WHEN USING SINGLE INSULATORS

Fig. 1 WIRE SPACING

PRINCIPLES OF ELECTRIC FENCES

When connected to an electric fence, a controller unit supplies some 60 or more electrical pulses a minute at a voltage of from 300 to 2,500 volts. If the fence is poorly insulated, for example, when tall grass has reached the lowest live wire, the charge leaks away almost immediately. When the fence is well insulated, the charge is held long enough to give a good "shock."

Most electric fence controllers can electrify satisfactorily several miles of well-insulated fence. The mains-operated units, however, are better than battery-operated units and remain effective even when the insulation of the fence is poor. The power consumed will cost about $2 a year, but mains units are superior, very reliable and operate continuously without maintenance.

1. PULSE RATE

It was thought that a fast pulse rate of 120 per minute was needed until stock learned to respect an electric fence. However, it is now found that *strong* pulses at 70 to 80 per minute are satisfactory at all times. In fact, New Zealand regulations insist that pulse rates be kept down to this level.

2. LENGTH OF FENCE

It has been found that many units will satisfactorily charge some 10 miles of electric fence in good order. However, this is placing a great deal of faith in one machine. If the length per electric controller is kept to three or four miles, maintenance will be reduced, and one fault in the fence will not be so serious. With old-type fence units, even three or four miles of fence with weed and grass growth could seriously reduce its effectiveness. The new low-impedance units can handle five miles or so of fence even under poor conditions.

3. INSULATORS

The numerous insulators available are shown in Fig. 2. **Tests have shown that both polythene and porcelain insulators are excellent when new and clean.**

If they are dirty, however, as when covered with salt spray along the coast, the porcelain insulators are slightly superior to polythene. The fence strain insulators (107) are very slightly better than egg insulators (110).

Both porcelain and polythene insulators are liable to deteriorate from heat, frost and sunlight. Poor quality porcelain insulators in a mountain fence line can develop fine cracks causing leakages that are difficult to trace. "Beattie" insulators have actually proved more reliable under these severe conditions.

In practice there is little difference in insulation ability, so the equipment should be chosen on factors such as price and suitability to the job.

If additional standards or posts have to be added to a fence, it is better to fit slotted polythene insulators rather than cut the wires to thread on insulators. Of course, wires can be attached to chain assemblies with clips or tie wires at any time.

4. INSULATION FAILURE

Sometimes loose wires and insulators are the cause of the trouble, but usually tall weed growth, particularly in wet weather, accounts for

the lack of "shock." The difficulty can be overcome at the start by bulldozing a fence line. However, bulldozing could start disastrous erosion in hill country. The fence line must be cleared somehow, but the risk of erosion must be kept in mind even if only a shovel is used at times. Weed-killers may be used to control later growth, or if a pure clover sward can be established beneath the fence, topdressing might keep it

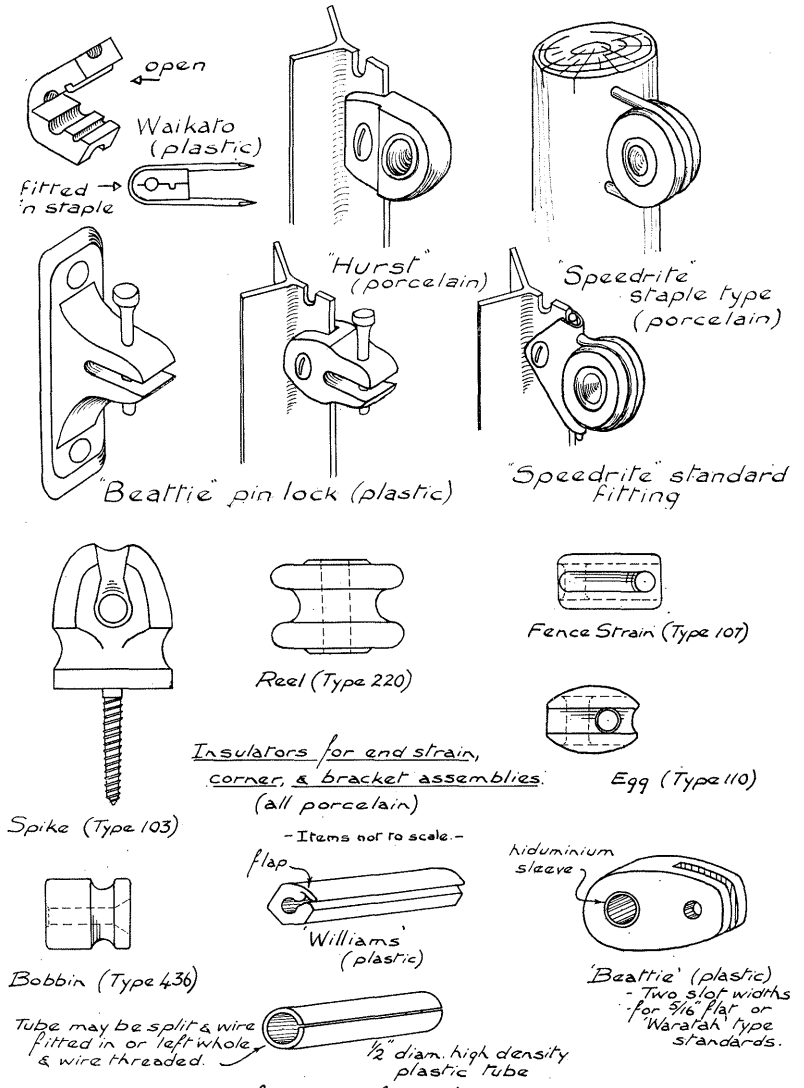


Fig. 2 **INSULATORS**

palatable to stock so that it would be kept grazed under the live wires of the fence.

But all electric fences need regular checking—once a month if possible. If stock have learned to respect an electric fence, they usually do not worry one that has ceased to be alive for several weeks. Monthly maintenance will keep the fence effective under normal conditions.

5. THE EARTH WIRE

This is the secret of effective long distance electric fences. The ground is by no means a perfect conductor when dry, and so animals get a much greater shock if they touch an "earth" wire connected to the "earth" terminal of the electric fence unit. Care must be taken to connect the earth wire across gateways.

Moreover, if connected (without insulation) to the earth wire, every waratah* becomes an earth peg. Then when an animal touches only a live wire, the current can return through the animal, and through a few yards of earth to the nearest waratahs which are connected directly to the earth side of the unit.

Electric fences with timber or concrete posts should be of the alternative live wire/earth wire type.

6. REGULATIONS

Electric fence controller units are subject to Government regulations under the Electric Wiring Act. The main points concerning the installation of units are:

(a) Only one unit can be connected to a fence.
(b) Wires must be clear of power and telephone wires.
(c) When used as a road or boundary fence, warning notices must be displayed.
(d) The earth terminal must not be connected to a house earth, or that of another appliance, and any earthing stake must be at least six feet away from another such earth.

TYPES OF FENCES

There are a number of variations of wire arrangements and of course many variations of the spacing of supports.

1. NUMBER OF WIRES

Five wires are enough for sheep, but cattle need six wires. If stock are inclined to jump, seven wires are better. The cost of an extra wire, roughly $20 including insulators, is worth it.

2. WIRE FENCES

A number of alternative wire spacings are given in Figs. 1a and 1b. Five wires can be spaced quite well on chain assemblies, but B.H.P. waratahs do not have suitable hole spacings for individual insulators. English "Y" standards and flat standards usually can be bought with holes punched to the farmers' specifications.

B.H.P. waratahs 5ft 6in. long, driven in until the bottom hole is just above the ground, then have six holes suitably spaced for an electric fence. The top wire is only three feet high, but this is satisfactory in many places.

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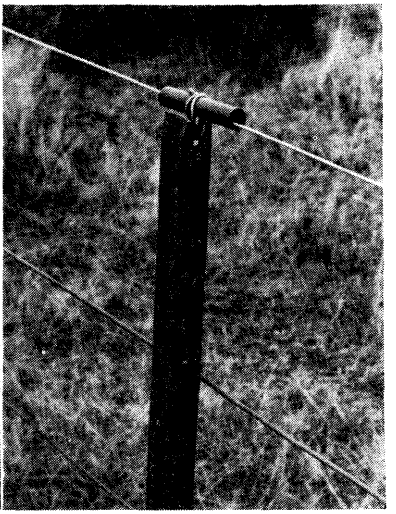
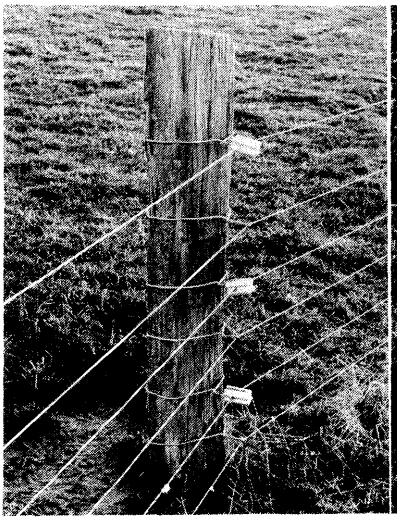
* *The word "waratah" is used throughout this bulletin as an abbreviation for "Y-section steel standard" for simplicity.*

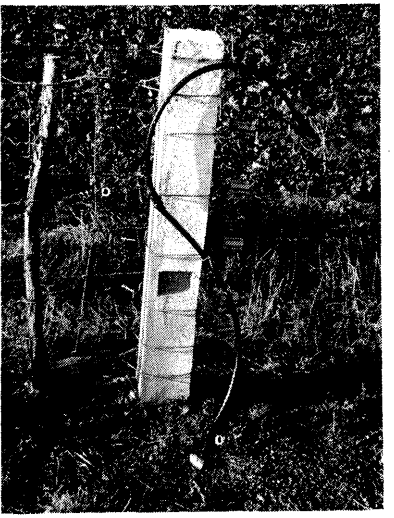
Use ordinary electric fuses at central points and find and disconnect short - circuited wires. Note the tin rain shields.



The top plain wire is insulated with cheap polythene insulators. This is cheaper and better than barbed wire when kept alive.



A corner post with insulators for the electric wire. The earthed wires are carried on wire loops to reduce costs.



A wire threaded through a plastic pipe takes the live wire under a gateway. The earth wire must be taken across the gateway too. Plastic covered wire is often used satisfactorily under gateways.

3. MULTI-EARTH SYSTEMS

Separate insulators, instead of insulated chains, allow two or three earth wires to be used instead of just one at the bottom.

The top wire is always alive and the bottom wire always earthed. In between are alternate live and earth wires.

In tussock country, I strongly recommend *two* earth wires at the bottom as this means that only vegetation over 15 inches high will touch a live wire. This improves the fence insulation considerably and so increases the shock. Most stock pressure is likely between the second and third wires (from the bottom) in such country so the stock will almost certainly touch the third wire, which is alive. By using 6ft waratahs with chain assemblies, an extra wire can be fitted below the normal earth wire. This is a very good fence.

A quickly-fitted chain assembly is available too, for a multi-earth system.

If an electric fence with chain assemblies is found to be rather low and prone to cattle damage, a light barbed wire could be strung along the top of the waratahs. This barbed wire would act as an earth wire as well as adding to the height of the fence and making it look more formidable.

Because of the wider spacing of supports, electric fences must have the top wire alive, or alternatively an earth barbed wire to protect them from cattle—never a plain earthed wire.

The multiple-earth system has much to recommend it. Dry ground is a very poor conductor of electricity so there is a much better shock between live and earth wires, compared to between a live wire and the ground.

4. FENCES WITHOUT INSULATORS

The new "low impedance" electric fence units are capable of making "live" long lengths, perhaps a mile, of *ordinary* fence. This is possible only if the posts are timber or concrete and provided there are no steel standards in the ground. Such old fences can be made cattle-proof temporarily by electrifying some of the top wires.

5. INSULATOR ATTACHMENTS

(a) **Chain and bracket assemblies:** These are illustrated in Fig. 3. Their main advantage is the speed with which they can be attached to the waratahs. Most assemblies have only two insulators, so the top four or five wires are all alive, but one firm offers an alternative multiple-earth assembly (see Fig. 3b). Their disadvantages are first the cost of assemblies, and second the difficulty of pulling wires through the chain.

(b) *Nut and Bolt:* The polythene and some porcelain insulators shown in Fig. 2 bolt to waratahs or standards.

Bobbin insulators can be fixed to the holes in waratahs—preferably with rubber washers as packing. Washers may be punched from old motor tyres for the job. Alternatively insulators may be bolted to small pieces of flat iron welded to the waratahs as in Fig. 1. This is a more expensive and slower method but allows the waratahs to be properly aligned in the fence. Special brackets are sometimes available but are generally too dear to be considered for permanent electric fencing.

(c) **Wire Ties:** Williams improved insulators (Figs. 2 and 3) are attached by plastic-covered wire. Each fence wire is easily pulled out along the fence line and strained up, then slipped into a slotted insulator at each waratah and held to it by the tie wire. Polythene pipe insula-

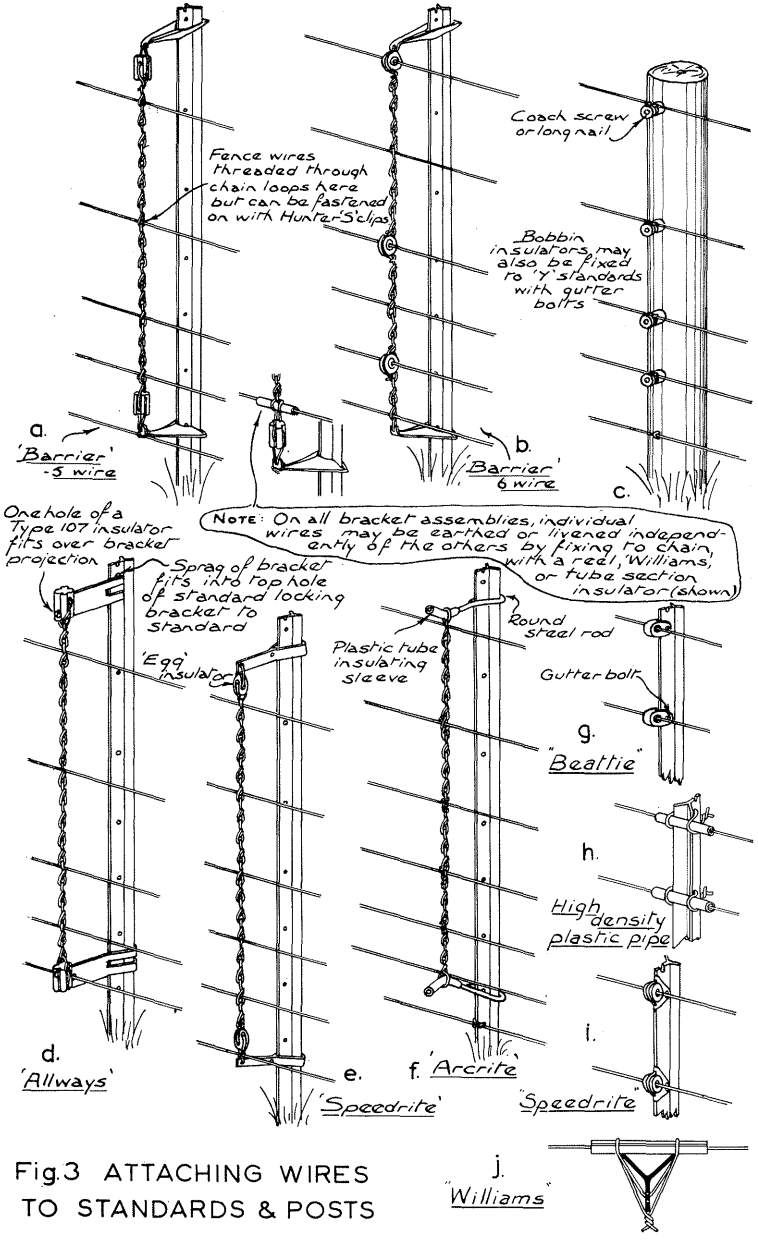


Fig.3 ATTACHING WIRES TO STANDARDS & POSTS

tors are attached by ordinary tie wires but they are not generally slotted except at the tie-downs. Instead, the insulators are first tied to the waratahs. Then the wires are threaded through them. Lacing wire of 14 gauge, or ordinary No. 12 gauge (not steel wire) may be used.

(d) **Nails and Screws:** These can be used to fix insulators to treated-timber stakes where the fire risk is not too great.

6. TIE-DOWNS

Manufacturers of chain assemblies supply a tie-down chain and insulator for fitting to a patent foot device, or to an anchor such as a waratah or half-waratah driven into the ground at an angle. If stainless steel wire is used, there is no early failure at ground level due to rusting.

"Hunter" fencing chain can be used at tie-downs. The porcelain or polythene insulators are attached to it by nuts and bolts, or by tie wires.

Earth wires attached directly to the tie-down chain are quickly fixed on by "Hunter" clips.

7. FENCE STRUCTURE

The aim in electrifying the fence is to reduce the number of posts and standards. Electrifying could cost the price of one to three waratahs per chain. Consequently less than half the usual number of waratahs should be used. This will result in supports spaced six yards apart (280 waratahs and 12 strainer and corner posts per mile). Such a fence is fairly stock-proof even if not electrified, and is recommended for remote fence lines and boundary fences—if the neighbours agree to it.

Many electric fences have been erected with waratahs spaced half to one chain apart. One manufacturer is now even suggesting one and a half chain spacing, presumably on a bulldozed fence line. The trouble with wide spacing is that stock do not see the fence easily, and cattle, particularly, may run over it if startled. To strengthen an electric fence when only the bottom wire is earthed, 12-gauge "Hunter" chain droppers may be fixed to the four or five live wires in between the waratahs. No insulator would be required as the earth wire would be left free. 2ft 4in. chain droppers cost about 8c each.

In general, a maximum waratah spacing of 10 yards is best for hill country. A satisfactory average spacing is seven yards and spacings as close as three yards may be needed over ridges.

The position of the earth wire can be varied. One manufacturer has his earth wire tied to the waratah several inches back from the line of the live wires. (See Fig. 3f.) The idea is that stock on the *bracket* side of the fence should be able to graze under the live wires and keep down tall grass and weed growth. A similar effect can be encouraged with other equipment by raising the brackets slightly and tying the earth wire to the waratah at the *base* of the bracket. But if the earth wire is threaded *through* the waratah, height adjustment is very limited. If two bottom earth wires are used, the second one could be fixed to the bottom bracket; or on the opposite side of the waratah from the first for separate insulator systems such as the "Beattie."

8. COMPOSITE FENCES

Using a netting fence with a live top wire has been mentioned. A section of this type can be inserted in an electric fence in places liable to heavy stock pressure, or in fertile gullies where rank growth may reach the live wires of an ordinary electric fence. The top live wire carries the current to the next section of fence, and the netting itself can be tied on to the earth wires.

It is also possible to save money by using the ordinary adjustable brackets together with cheaper polythene insulators. Bracket assemblies would be used on rocky stretches where it is difficult to drive waratahs. Cheaper insulators would be used wherever waratahs could be easily driven to the correct depth.

Changes from single-earth to multiple-earth systems should be avoided as much as possible, but a change can be made at strainers if necessary.

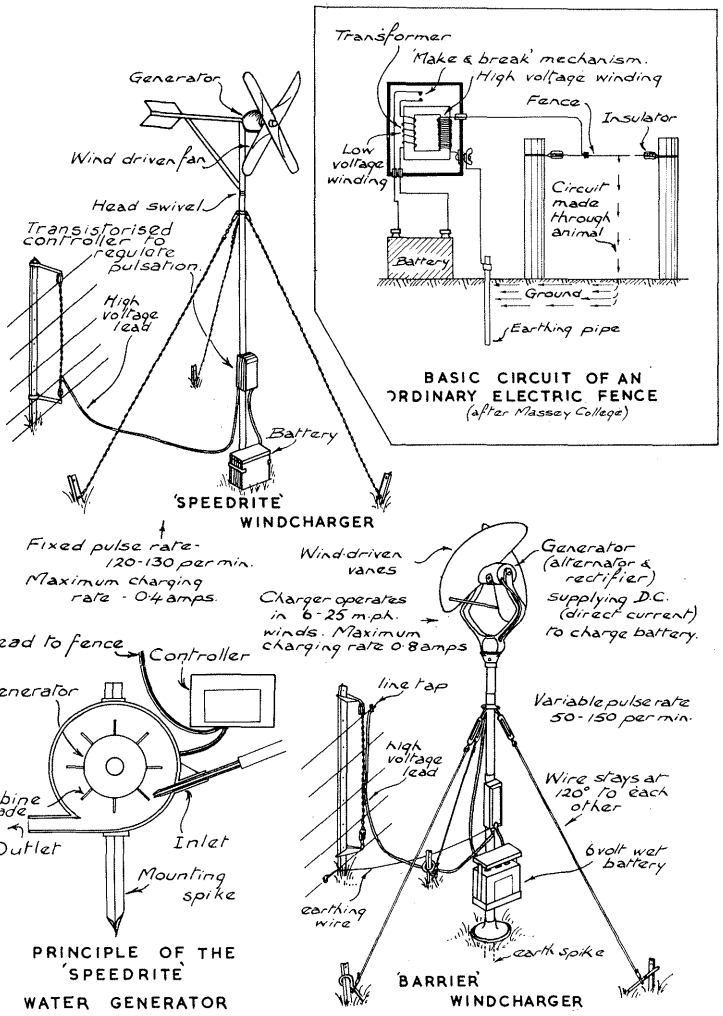
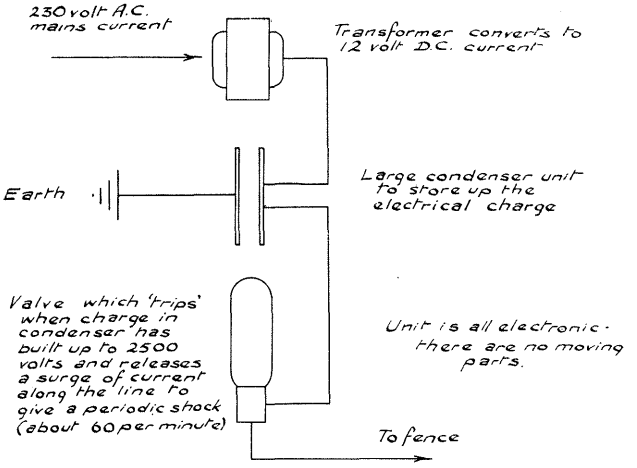
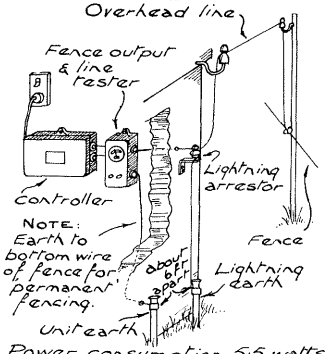


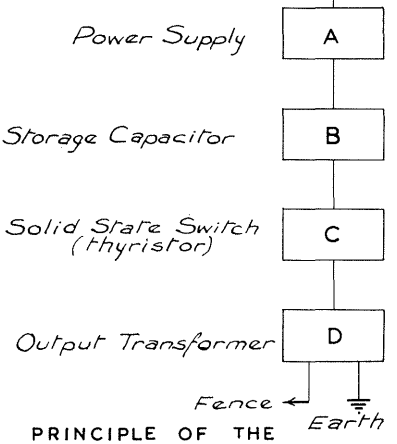
Fig. 4 a. CONTROLLERS & CHARGERS



PRINCIPLE OF THE 'WAIKATO MAINS CONTROLLER



'AKO' MAINS OPERATED ELECTRIC FENCE UNIT



PRINCIPLE OF THE 'SPEEDRITE' LOW-IMPEDANCE MAINS OPERATED CONTROLLER

Fig 4b.

MATERIALS AND EQUIPMENT

1. POSTS

In hard, dry, stony country, light 7ft strainers of treated timber are good. They are light to carry and easy to handle on hillsides. A standard 6ft wooden post with a minimum diameter of five inches will usually do for an angle post which is tied back. **Posts treated with "green salt" preservative are less inclined to burn than untreated wood.** They are quite suitable for tussock country and normal farm use. But in softer ground a larger strainer post may be needed. On easy country, concrete posts may be preferred.

T-iron posts should be used on hill country if the fire risk is high.

TABLE 1. EXAMPLES OF POSTS

Post	Weight	Cost approx.	Strength Group
(a) **Treated Radiata Pine**			
Post 5ft 6in. 4in. diameter		$0.64	
„ 5ft 6in. 5in. „	25lb	$0.79	
„ 6ft 4in. „	25lb	$0.68	
„ 6ft 5in. „	30lb	$0.89	1,500lb
„ 7ft 7in. „		$2.50	
„ 7ft 6in. „		$2.00	
Stay 8ft 4in. „	40lb	$1.00	
(b) **Concrete**			
Post 5ft 6in.		$1.00	
„ 6ft	85lb	$1.06	300lb
„ 6ft 6in.—6in. x 6in.		$4.00	
„ 7ft —6in. x 6in.		$4.20	
„ 7ft —7in. x 7in.		$4.70	
Long stay 8ft		$1.80	
Block		$0.40	
(c) **Steel T**			
2in. x 2in. x ¼in.—6ft	19¼lb	$2.25	
2½in x 2½in. x ¼in.—6ft 3in. (Three from 20ft length)	27lb	$3.00 (Material $2.25)	370lb

2. WIRE

In general, No. 12½ gauge galvanised high-tensile steel wire is recommended. This smaller diameter wire expands and contracts less than No. 8 wire but in extreme cold may become brittle and very easily snapped if overstrained. For this reason, **ordinary galvanised wire should be used in fences over 3,000ft altitude.** No. 10 gauge is the minimum size that could be considered. It would be hard to thread through chain assemblies but will easily go through porcelain or polythene insulators.

TABLE 2. WIRE FOR ELECTRIC FENCES

Size	Length in ½cwt Coil (approx.)	Maximum Working Load*	Cost per Mile — 80 chains— (approx.)		
			1 wire	5 wire	6 wire
12½ gauge	738 yards 33 chains	550lb	1¼cwt $13.90	6¼cwt $69.70	7½cwt $83.60
No. 10 gauge	427 yards 19 chains	600lb	— $19.63	10¾cwt $98.00	13cwt $118.00
No. 8 (for comparison)	273 yards 12 chains	650lb	3cwt $30.22	17cwt $150.40	20cwt $181.00

***Note: A final tension of 300lb is best. Strain to 250lb on very hot days and to 350lb in very cold weather.**

Fully-galvanised grades of these wires should all last over 100 years unless the protective zinc is scraped off by pulling wires through the waratahs.

Make sure the waratahs are driven so that the wires can be threaded through the smooth side of the holes.

Twelve and a half gauge high-tensile wire can be joined by twisting the wires around each other several times then hooking the loose ends together to prevent them unwrapping.

Another satisfactory knot is the figure eight. A patent sleeve joint often used for joining high-tensile netting is convenient and also makes a first-class electrical contact. In multiple-earth fences, the ends of the live wires must be carried back over the knot and a sound joint made with a line tap. Alternatively the joint could be made around a quarter-inch bolt and wrapped with sealing tape.

Because of complicated end-insulators and "carry-over" electric wires at strainers, use permanent strainers to simplify maintenance. They cost 38c each, i.e. $1.90 for a five-wire strain and $2.28 for a six-wire strain.

3. INSULATORS, BRACKET ASSEMBLIES AND TIE-DOWNS

The components available are listed in Table 3.

Insulators

Most items can be bought singly. "Williams" insulators come in boxes of 100, complete with plastic-covered wires, or staples for posts. Nuts and bolts are supplied for "Beattie" insulators, but you must be careful to order the right type, i.e. permanent type for either waratahs or for flat standards.

Bobbin, "Beattie," "Waikato" and "Williams" insulators are all particularly useful for approach lines. Bobbin insulators could be used also with waratahs for a multi-earth fence, but really need packing out about three-eighths of an inch with washers to give the live wires clearance from the waratah. Washers can be cut from an old motor tyre with a hollow die, in the farm workshop.

At strainers and corners use ordinary 107 porcelain insulators and No. 8 gauge wire. They are cheap and satisfactory. However, the manufactured chain and insulator is more quickly fitted. Heavier and more expensive 210 insulators can be bought if desired. Spike 103 insulators are suitable for wooden corner posts where a stay is preferred to a tie back.

"Beattie" and "Hurst" insulators are very effective on waratahs and standards. "Williams" insulators and home-made polythene tube insulators are cheaper but sometimes cause trouble by pulling out from their tie wires.

Bracket Assemblies

The steel parts of manufactured bracket assemblies are either galvanised or painted for rust protection. "Barrier" offer both live fence and multi-earth equipment and so you must be careful to order the right one. You can change the type at a strainer but if materials are left over they cannot be mixed together elsewhere.

"Arcrite" make bracket assemblies for either 5ft 6in. or 6ft waratahs, so again, the order must be specific.

Tie-downs

Tie-downs can be made up from No. 10 or No. 8 wire but it takes time to make them up, fix insulators, and get wire spaces correct. But 9 or 10 gauge *chain* saves time and gives a neater fence. Several manufacturers sell ready-made insulator-and-chain fittings, but you can make similar ones cheaper on the farm from "Hunter" chain brought in a roll and cut in 3ft lengths. In firm ground, half a 6ft waratah, a 4ft 6in. standard, or a whole 5ft 6in. waratah usually have enough grip. For deep gullies with soft floors stronger anchors of crossed waratahs or treated stakes may be needed, or perhaps even buried anchor blocks of concrete, stone, or treated timber. (Waratahs can be cut part way through and are then easily broken.) Stainless steel 12-gauge wire is best for all tie-downs.

For small dips, where the wire needs to be pulled down only one or two feet, a cranked waratah may be used. The waratah is driven into the ground at an angle to it but in line with the fence. It is then held with the boot at ground level while it is bent upright through about 40 degrees. Insulators or a bracket assembly are then fixed on.

The patent arrowhead, or steel-plate foot, is satisfactory for a fairly deep hollow if it can be driven well into firm clay. Unfortunately many South Island hill and mountain soils are stony and shallow. Here it is difficult to drive in the patent foot and on wet slopes they can pull out.

Driven half-waratahs, with chains and insulators, are quick to install and economical. Wires are easily pulled down and attached to the chain with Hunter clips. Short lengths of ordinary 12-gauge wire could be used in place of clips.

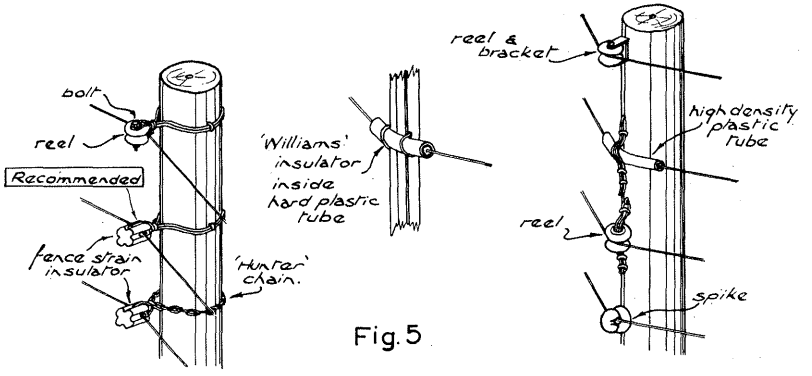


Fig. 5

VARIOUS CORNER AND BEND ASSEMBLIES.

4. ELECTRIC FENCE CONTROLLERS AND BATTERY CHARGERS

(a) **Mains Operated:** The mains units sold in New Zealand give a much higher voltage than ordinary battery operated units. Moreover they give high voltages, and a good shock even on poorly-insulated fences. So great is their advantage that I strongly recommend that **a mains unit be used wherever possible,** even if a mile or so of approach line is needed.

TABLE 3

Item	Cost	Comments	Cost with 5ft 6in Waratah
1. Porcelain Insulator 107	11-12c	Used at strainers, angles and tie-downs.	—
2. Porcelain Insulator 110	8c	Tie-downs and approach lines.	—
3. Plastic Reel Insulators	14c	Corners and strainers.	—
4. "Arcrite" Bracket, etc. Tie-down	79c 60c	For live fence and bottom wire earthed. Adjustable for height.	$1.37
5. "Barrier" Bracket, etc. (Standard) Tie-down chain	85c 43c	For live fence and bottom wire earthed. Adjustable for height.	$1.43
6. "Barrier" Bracket (multi-earth) Tie-down chain	$1.15 74c	For alternate live and earth wires. Adjustable for height.	$1.73
7. "Beattie" Permanent Insulators (polythene), or "Speedrite" waratah Insulators (porcelain) Tie-down chain (with 3 insulators)	15c 55c	Insulation of waratahs, standards and tie-down chains for multi-earth system.	$1.03 (3 insulators)
8. "Hurst" (porcelain) Insulators for waratah or flat standard Tie-down chain (with 3 insulators)	12c 46c	Insulation of waratahs, standards and tie-down chains for multi-earth system.	94c (3 insulators)
9. Polythene Pipe (home-made insulators) (4in) Tie-down chain	2c 16c	Waratah and tie-down insulators attached by plain tie wires.	64c (3 insulators)
10. "Speedrite" Bracket, etc. Tie-down chain	72c 44c	Live fence system with bottom wire earth. Adjustable for height.	$1.30
11. "Williams" Insulators Tie-down chain	7.3c 32c	Waratah and tie-down usually for multi-earth system.	80c (3 insulators)
Alternatives to Steel Fence—			
12. (a) 5ft 6in Hardwood standard Polythene Pipe (home-made insulators) Tie-down chain	36c 2c 16c	Insulators attached to stake with 14 gauge plain wire.	42c
(b) 6ft thin treated post (preferably driven)	68c		
13. "Waikato" Insulator (polythene)	8c (for 3)	Insulators stapled to post.	76c (3 insulators)
14. "Williams" (polythene)	7.3c	Stapled to posts.	90c
15. "Speedrite" (porcelain) with staple	7c	Stapled to post.	89c

TIE-DOWN

Description	Cost
One Insulator 3ft of 9 gauge chain half waratah.	56c
Above with whole waratah.	83c
One Insulator, chain and half waratah.	53c
Above with whole waratah.	80c
Not suitable.	
Chain and insulated stirrup with half waratah.	91c
With 4ft 6in standard.	$1.11
With 5ft 6in waratahs.	$1.18
Tie-down Arrowhead and stainless steel wire.	$1.10
Tie-down with half waratah.	74c
Tie-down with 4ft 6in standard.	94c
Tie-down with 5ft 6in waratah.	$1.01
Tie-down Arrowhead and stainless steel wire.	$1.28
Tie-down with half waratah.	$1.65
Tie-down with 4ft 6in standard.	$1.25
Tie-down with 5ft 6in waratah.	$1.32
Cranked waratah 3 insulators.	$1.03
On 9 gauge chain with half waratah	86c
With 4ft 6in standard.	$1.06
With 5ft 6in waratah.	$1.13
Cranked waratah, 3 insulators.	94c
On 9 gauge chain with half waratah	77c
With 4ft 6in standard.	97c
With 5ft 6in waratah.	$1.04
Cranked waratah.	64c
Chain with half waratah.	47c
Chain with 4ft 6in standard.	67c
Chain with 5ft 6in waratah.	74c
Tie-down, plate and stainless steel wire.	84c
Tie-down with half waratah.	75c
Tie-down with 4ft 6in standard.	95c
Tie-down with 5ft 6in waratah.	$1.02
Waratah cranked chain with 3 insulators.	80c
With half waratah.	63c
With 4ft 6in standard.	83c
With 5ft 6in waratah.	90c
Standard tied to extra angled stake	78c
Chain with stake.	52c
Footed post.	96c
Post tied to 5ft 6in waratah.	$1.34
Footed post.	$1.10
Post tied to 5ft 6in waratah.	$1.48
Footed post.	$1.09
Post tied to 5ft 6in waratah.	$1.47

STRAINER AND ANGLE INSULATORS

Description	Cost		
	3 live	5 live	Angle Posts
Insulator attached with wire.	33c	55c	66c
Not recommended for this purpose.			
Insulator attached with wire.	42c	70c	84c
Use 107 Insulators.			
Use 107 Insulators as in (1) above)			
or 210 Insulators	$1.17	$1.95	
or 103 Insulators			$2.28
Chain and Insulator @ 29c.			$1.74
As above.			
Use 107 insulators.			
Use 107 insulators.			
Use 107 insulators.		See (1)	
Use 107 insulators.			
or Chain and Insulator @ 31c.	93c	$1.55	$1.86
Use 107 Insulators.		See (1)	
Use 107 Insulators.		See (1)	
Use 107 Insulators.			

A great point in its favour is also that a mains unit does not need regular attention. Although some parts eventually fail or wear out, almost no maintenance is needed. Power failures are generally only for a few hours. Normally you would not expect trouble with stock in that time unless they were being shifted.

(b) **Battery Operated:** Several battery units are available and all of those tested, except one 6-volt condenser type unit, appeared suitable for permanent electric fences of two or three miles long. However another condenser-type unit operated by 9-volt dry batteries proved better than average. A 12-volt "low impedance" model proved as effective as any mains unit so could be used for five miles or so of fence.

(c) **Battery Chargers:** Normally a farmer charges his electric fence batteries with a small **mains battery charger** costing about $16. A spare battery, or an old car battery capable of operating the fence for a day or two, is needed while the other is being charged.

Where it is not convenient to recharge the battery every month, as in isolated places, **wind chargers** can be bought for $111. The cost per mile is quite reasonable when the controller serves five miles or so of fence.

It was hoped that wind chargers would keep batteries permanently charged so that inaccessible fences could be left, for example, over winter without attention. In practice, however, long periods of fairly calm weather for several weeks can result in a discharged battery liable to be damaged by frost. It is also difficult to site wind chargers so that they are able to use the prevailing breezes without also being exposed to 70 mile per hour storms.

A battery charger driven by a **water turbine** can now be bought for use in hill country (price about $60). (Fig. 4a.) It needs a reliable stream with a fall of about 25 feet in 200 yards, and capable of filling a three-quarter-inch pipe (250 gallons per hour). The pipe will cost some $25 to $50 extra. A one-inch pipe may be needed for longer distances. The charger and the water intake should be checked regularly to see that the turbine bearings are not overheating. The risk of frost damage should not be overlooked. In a hard winter freeze-up, it may be best to disconnect the turbine and drain it.

For isolated fences rarely visited, I recommend the dry battery 9-volt unit. Six No. 6 dry cells ($5) should last 9 to 12 months. This compares favourably with the cost of wet batteries and a mains charger over the years, and is certainly cheaper than a wind charger.

5. ACCESSORIES AND TOOLS

(a) Number 8- or 10-gauge galvanised wire will be needed for tieing-on insulators to strainers, tie-backs at strainer and corner posts, and perhaps for tie-downs. If fencing materials have to be carted out by pack-horse, extra wire will be needed for making up loads. At least one coil per mile should be provided. Fourteen-gauge lacing wire may be needed for tieing-on insulators.

Stainless steel wire is best for tie-downs. $1.60 buys about 66 feet of 14-gauge stainless steel wire.

(b) Heavy staples will be needed if wooden strainer and corner posts are used. (Two pounds per mile.)

(c) Permanent strainers at 38c each are recommended—they make it easy to keep the wires tight.

(d) Isolating fuses to disconnect lengths of fence when fault-finding, are a great advantage. Thirty-amp cut-outs cost $1.38 each but ordinary electric-light switches or switch-board fuses are equally effective and cheap enough to be fitted at the end of each strain. "Arcrite" cut-out plugs cost 85c each.

(e) Gate-way wires are needed to carry earth and live wires over to the next strain. The live wire may be:—

(i) An insulated plastic wire, 1/.044 T.P.S., costing about 10c per yard.

(ii) Light "lacing" wire attached by insulators to masts 8 to 12 feet high.

(iii) Wire threaded through buried polythene pipe (cost 5c per foot).

The earth wire can be a plain galvanised wire buried underground but it would need inspection and replacing after several years. If 20-gauge stainless steel wire (costing about 8c per yard) is used it would need no maintenance. If masts are used to carry the live wire over the gateway, the earth wire is attached six inches below the live wire.

(f) End connectors or line taps (20c each) ensure good joints when wire ends are joined together. They are slotted bolts with nuts, and can be fitted over two wires and tightened up to clamp them together. Gutter bolts and washers are cheaper but much less satisfactory alternatives.

Plastic, waterproof, insulating tape to protect the joint from the weather and prevent corrosion costs 38c a roll.

(g) Explosives may be needed in rocky country. A sound knowledge of their use is essential. Each posthole requires two to five ounces of gelignite at an average cost of 30c.

(h) To prevent waratahs sinking into softer ground on rises, ground plates can be used costing about 20c each complete with wedge.

(i) Digging tools will be needed, e.g. spade, shovel, crow-bar. In rocky country, a portable motor-driven rock drill such as the "Cobra" is very useful. They cost about $600 but can sometimes be hired.

(j) Fencing tools needed will depend on the job, e.g., claw hammer, 5lb hammer, wood chisel, fencing pliers, files, strainer, permanent-strainer, waratah driver and axe.

Special tools:

(i) Driving rod if patent foot tie-down is to be used.

(ii) Hunter clip tool.

(iii) Electric fence tester. Simple neon-tube-type testers are available costing about $2 but the dial type electric testers costing about $18 show better whether the fence is effective.

(iv) Sleeve crimping tool for easy jointing of 12½-gauge wire $17.17) and packets of 100 sleeves ($7.00).

(v) Pocket balance 0 to 25lb for a wire-strain gauge ($1.00). See Fig. 10.

COSTS OF ELECTRIC FENCING (Calculated examples)

TABLE 4. COSTS PER MILE

Basic Data for Costs	Type 1 Difficult Hill Country	Type 2 Rolling Country		Type 3 Flat Land
	6 wire	5 wire	6 wire	6 wire
Number of strains	5	5	5	5
Average length of strain	16 chain	16 chain	16 chain	16 chain
Number of strainers	6	6	6	6
Number of corner posts	8	6	6	4
Number of waratahs	220	230	230	240
Tie-downs—Deep gully	10	10	10	—
Shallow dip	40	30	30	10
Average waratah spacing	7 yards	7 yards	7 yards	7 yards
Strainer posts and stays	$19	$24	$24	$24
Corner posts and tie-backs	15	11	11	8
Wire 12½ gauge steel	85	71 (6¼cwt)	85 (7½cwt)	85
Waratahs 5ft 6in.	128	134	134	140
Gateway allowance	10	15	15	20
Quarter cost of controller; permanent strainers, etc.	24	22	24	24
Basic cost (sub total)	**$281**	**$277**	**$293**	**$301**
(1) **"Arcrite"**				
Basic Cost	$281	$277	$293	$301
Insulators, Tie-downs, etc.	160	140	150	120
Transport (1-2 tons)	230	226	226	203
Erection	30	15	15	15
"Arcrite" Total	$701	$658	$684	$639
(2) **"Barrier" Standard**				
Basic Cost	$281	$277	$293	$301
Insulators, tie-downs, etc.	232	233	233	216
Transport (1-2 tons)	30	15	15	15
Erection	160	140	150	120
"Barrier" Standard Total	$703	$665	$691	$652

Basic Data for Costs	Type 1 Difficult Hill Country	Type 2 Rolling Country		Type 3 Flat Land
	6 wire	5 wire	6 wire	6 wire
(3) **"Barrier" Multi-earth**				
Basic Cost	$281		$293	$301
Insulators, tie-downs, etc.	303	Not	305	289
Transport (1-2 tons)	30	Suitable	15	15
Erection	160		150	120
"Barrier" Multi-earth Totals	$774	—	$763	$725
(4) **"Beattie" (Multi-earth) or "Speedrite"**				
Basic Cost	$281	$277	$293	$301
Insulators, tie-downs, etc.	150	147	147	121
Transport (1-1¾ tons)	30	15	15	15
Erection	176	150	160	140
"Beattie" Totals	$637	$589	$615	$577
(5) **Polythene Pipe**				
Basic Cost	$281	$277	$293	$301
Insulators, tie-downs, etc.	45	41	41	24
Transport (1-1¾ tons)	30	15	15	15
Erection	176	150	160	140
Home-made Totals	$532	$483	$509	$480
(6)**"Speedrite" (Chain type)**				
Basic Cost	$281	$277	$293	$301
Insulators, tie-downs, etc.	208	206	206	186
Transport (1-2 tons)	30	15	15	15
Erection	160	140	150	120
"Speedrite" Totals	$679	$638	$664	$622

Basic Data for Costs	Type 1 Difficult Hill Country	Type 2 Rolling Country		Type 3 Flat Land
	6 wire	5 wire	6 wire	6 wire
(7) **"Williams"**				
Basic Cost	$281	$277	$293	$301
Insulators, tie-downs, etc.	88	84	84	64
Transport (1-1¾ tons)	30	15	15	15
Erection	176	150	160	140
"Williams" Totals	$575	£526	$552	$520

Alternatives to Steel Standard Fence

(8) **Hardwood Standards with Polythene Pipe Insulators**				
Basic Cost	$233	$216	$242	$248
Insulators, tie-downs, etc.	45	41	41	24
Transport	40	20	20	20
Erection	176	150	160	140
	$494	$427	$463	$432
(9) **Treated 6ft Posts with "Waikato" Insulators**				
Basic Cost	Not	$317	$343	$331
Insulators, tie-downs, etc.	recom-	33	33	26
Transport	mended	20	20	20
Erection		210	220	200
		$580	$616	$577
(10) **Treated 6ft Posts with "Williams" Insulators**				
Basic Cost	Not	$317	$343	$331
Insulators, tie-downs, etc.	recom-	71	71	61
Transport	mended	20	20	20
Erection		210	220	200
		£618	$654	$612

All fences are costed with treated-timber posts, stays for strainers and tie-backs for corner posts; B.H.P. waratahs; and permanent strainers on every strain. Patent chain insulators for corner and strainer posts have been costed where the manufacturer supplies them (Examples (2) and (3)). For the other fences, 107 insulators have been allowed for, with slightly higher erecting costs for the extra work in fitting them.

Patent tie-downs were costed in the "Speedrite" chain example (6). Chain and half-waratahs were considerably cheaper than "Barrier" patent tie-downs, so were used in example (2).

The transport costs given for type 1 fence materials on farms, are about 80 miles from a main centre, plus some cartage on the farm. The transport costs for types 2 and 3 should take the materials 50 miles from a main centre. The erection costs used are considered reasonable for fencing contractors and farmers who have had some experience with electric fencing. The difficult-country fence type 1 would cost more to erect because more materials are needed and the site cannot be reached by a vehicle.

ORDINARY FENCING COSTS FOR COMPARISON

(a) **Legal boundary fence:**
Per mile: 309 concrete posts; 12 strainer and angle posts; six No. 8 wires and one No. 12 gauge barbed wire; and 1,280 treated pinus droppers (battens).

Materials	$793
Transport (8 tons)	57
Erection	340
TOTAL COST PER MILE	$1,190

(b) **Seven-wire Subdivision Fence:**
One post, three waratahs and four standards per chain. Materials $638 per mile. Total costs per mile.

Easy country	$1,000
Difficult country	$1,080

(c) **Seven-wire—post and batten:**
Two posts and 10 galvanised steel battens per chain with six No. 8 and one barbed wire.

Materials	$575 per mile
Total cost easy country	$957 „ „

(d) **Netting Subdivision Fence:**
One post and three waratahs per chain with 34-inch netting and one barbed wire.

Materials	$670
Total costs per mile:	
Easy country	$1,013
Rolling country	$1,093

(e) **High-country Fence:**
Per mile: 20 steel posts; 160 5ft waratah standards; 400 4ft 6in. flat standards; three No. 8, three No. 12½ high-tensile and one barbed wires. Strains of 12-chain length.

Materials	$500
Transport	60
Erection	$400
Total	$960

An old fence strengthened with an occasional post, a few waratahs and a top live barbed wire.

SITING, AND ORDERING MATERIALS

The siting of a fence line and the listing of materials for it must go hand in hand. Standards or stakes can be used to mark the line.

In hilly country it is usual to site the fence line along ridges. However, to avoid having too many corners, **it is good practice to cross some of the shallower hollows and keep the fence line straighter.** However on very steep ridges, or where scrub must be bulldozed aside, it may be best to keep strictly to the ridge. The following points are worth noting:

(a) **Cover:** Electric fencing is not very suitable for country covered in gorse, high bracken fern, or scrub. In the first place, a track must be cleared by hand, or by a bulldozer at a cost of some $50 or more per mile. Unless the track is a wide one, cattle using the fence line as a path may damage the fence, and, in the event of fire, insulators may be destroyed. For the same reason, fire is again a danger where there is heavy tussock. Also, regrowth must be cut back or sprayed regularly to prevent it overgrowing the bottom live wire. Even tussock in wet weather reduces the power of a long electric fence to a very low level.

(b) **Slope.** As with normal fencing, electric fences should not cross steep slopes because of the danger of stock getting trapped and pushing through the fence. Boulders rolling down the slope can also be a problem. However, if the hillside has to be fenced, a sturdy electric fence may allow boulders to roll through without causing as much damage as to a conventional fence. In cold regions

No. 10 gauge ordinary galvanised wire could be better, as high-tensile wire is more likely to snap if struck by a boulder in frosty weather.

Slip faces, waterways, and shingle slides too, should be avoided if possible when fencing around a hillside. On steep slopes in the South Island the danger of snow drifts carrying away the fence should be borne in mind.

(c) **Gullies:** Since in mountainous regions the spurs are often very rocky, gullies may seem attractive for fence-lines. However, although it is perhaps easier to dig post-holes and drive waratahs here, the gully may twist and turn requiring many corner-posts. There is also the danger of boulders smashing porcelain insulators and the risk of washouts from a cloudburst.

Nevertheless, a wide gully may be satisfactorily electric-fenced if suitable materials are chosen, and a sturdy fence is erected. In wet areas the waratahs may need ground plates, and if rushes are tall, perhaps a section of netting with a live top wire might be the answer.

(d) **Rugged country:** Where a region is very broken with numerous humps and hollows, and it is difficult to space waratahs seven or eight yards apart, it may still be possible to use an electric fence by:

(i) Bulldozing the fence line.
(ii) Shovelling heaps of earth from the humps into the hollows.
(iii) Occasionally using a cranked waratah as a tie-down. (See "f" Fig. 7).

Before the natural cover is disturbed by bulldozing and shovelling however, assess the dangers of wind and water erosion, and plan the fence line to avoid trouble. Rocky areas too, should be avoided as much as possible.

(e) **Altitude and Temperature:** In the mountain regions of the South Island *normal* fencing should be used in cold, inaccessible country, particularly above 3,000 feet, for the following reasons:

(i) Inaccessible fencing is difficult to maintain.
(ii) Trouble spots in ordinary fencing can often be guessed at, but faults in an electric fence can happen anywhere.
(iii) Porcelain insulators may not stand severe weather conditions.
(iv) 12½ gauge steel wire is liable to snap in extreme cold, and on the other hand it is severely damaged by fire.

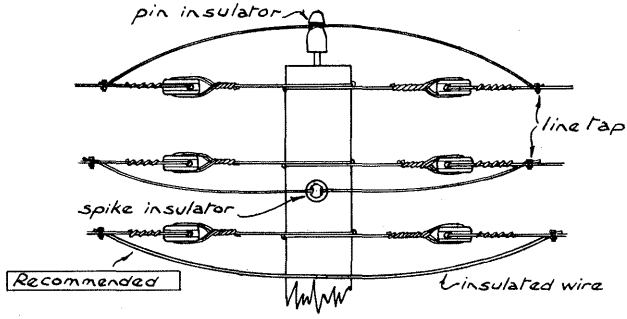
(f) **Streams** may be crossed by using a flood gate or netting attached to a wire rope. The live wire can be stretched across the stream from the end posts or from masts.

(g) **Gateways** and holding paddocks should be grouped together as much as possible, as greater strength and more "dead" section will be necessary here.

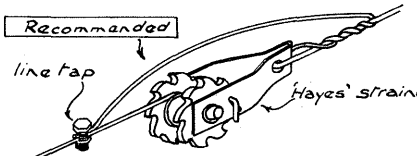
ESTIMATING MATERIALS

As the fence line is marked, the materials can be estimated. Distances should be chained if possible, or paced out.

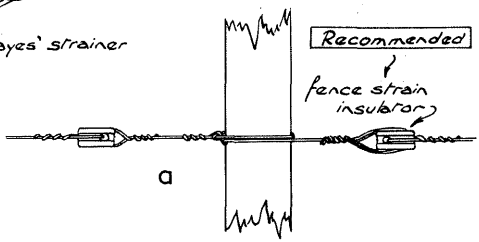
It is very difficult to tell exactly where tie-downs will be required before the wires are strung out, and a liberal estimate should be made.

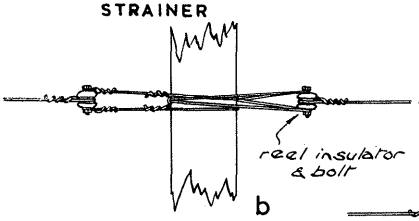


1. THREE WAYS OF CONNECTING LIVE FENCE WIRES

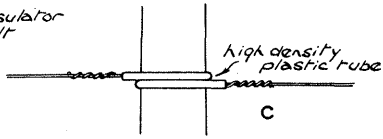


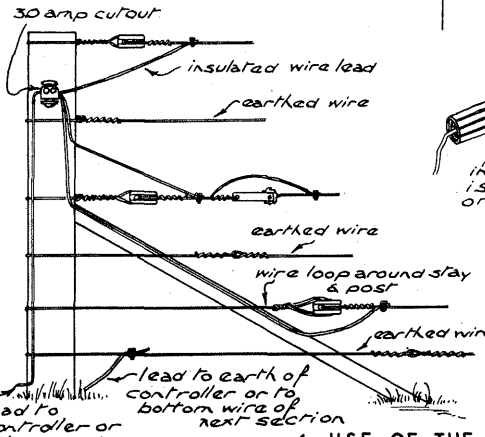
2. CORRECT JOINTING ACROSS A PERMANENT STRAINER

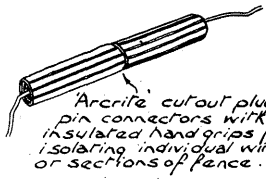




3. INSULATING AT STRAINER POSTS







* Cog strainers (eg. Hayes) may be fitted at end of strains but are better half way.

* Line taps should be bound with waterproof tape. (e.g. 'Denso')

4. USE OF THE ISOLATING CUTOUT

Fig.6 INSULATING AT STRAINERS

FENCE CONSTRUCTION

1. **GENERAL PROCEDURE** (after clearing the fence line if necessary).

(a) Using a guidewire, put in the strainer and corner posts and fit them for insulators and permanent strainers as required. Then run out the bottom earth wire and use it as a guide line for the waratahs. Some tie-downs may be needed in the deep dips. The waratahs are now driven to their correct height. This is found by fitting the first waratah with insulator equipment. Then fit the insulators or bracket assemblies and run out and fix the other wires. Tie-downs are then fitted, the earth wire tied on at the bottom, and the wires strained. Finally make secure water-tight connections to the electric fence unit, or to another section of electric fence.

(b) If the waratahs are lined up by sight instead of using a guide-wire, drive "sighting" waratahs on the rises. Then drive a straight line of waratahs in between. This takes a little skill but allows the earth wire to be threaded *through* the waratahs as for multi-earth single-insulator systems. Now dig-in the posts and fix insulators to them and to the waratahs. Then the wires can be pulled, tie-downs installed, wires strained, and connections made.

2. STRAINERS AND CORNERS

At strainers, either stays can be fitted or better still, an end-assembly such as shown in Fig. 8 (c), can be constructed. This is lighter and stronger than the usual method.

In some cases fence lines can be gently curved to follow gullies, using ordinary waratahs or light posts and insulators.

Methods of attaching insulators and fuse cut-outs to permanent strainers are shown in Fig. 3. **I recommend using the 107 insulator and wire for cheapness and effectiveness.**

Note that earth wires are often run through an insulator at the corner posts, to keep them in line and making pulling out easier. Strains may be up to 30 chains long then, if convenient.

3. ELECTRIC FENCE EQUIPMENT

Chain assemblies, insulators, and tie-downs are illustrated in Figs. 4 and 5. Before fitting the equipment, the instruction booklets or leaflets supplied by the manufacturers should be studied. Many fences have given trouble simply because of poor construction. Points to note with the different types of equipment are:

(a) **"Arcrite":** Make sure the right chain assemblies are ordered for the size of the waratahs being used, and note that the waratahs should be turned slightly to keep the brackets at right angles to the fence. Otherwise the wire may be too close to the waratah. If large-size brackets have to be fitted to 5ft 6in. waratahs, the chain can be shortened by wiring up a link, or simply twisting the rings on the insulators.

The waratah must be driven in to the correct height if the bottom wire is to be threaded through its lowest hole. (See Fig. 3f.) Usually the wire is simply tied to the base of the bracket.

Look at the illustration before assembling the tie-downs.

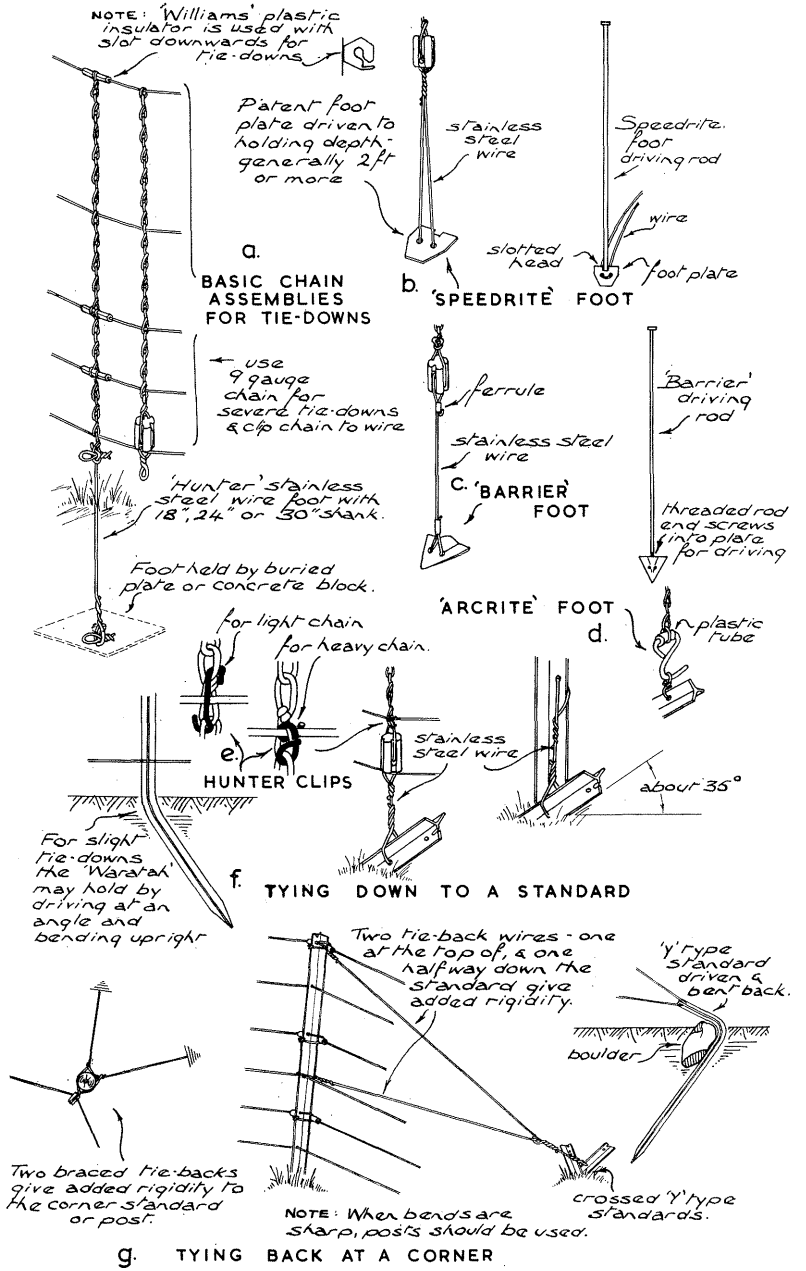


Fig.7 TIE-DOWNS & TIE-BACKS

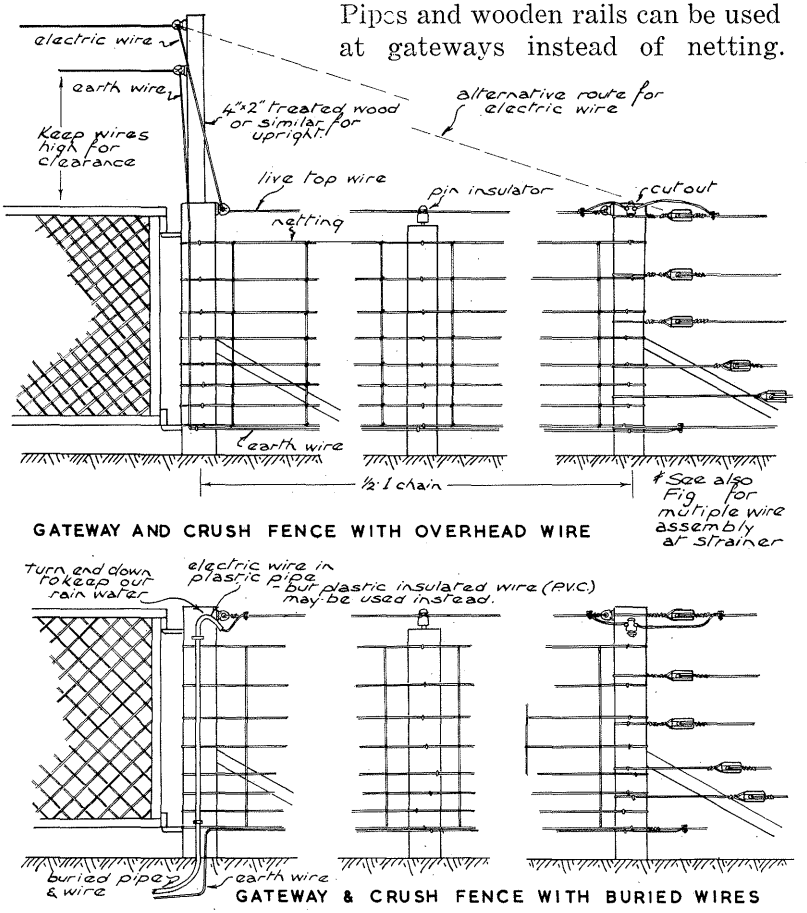


Fig.8 GATEWAYS

(a) **"Barrier":** (Standard). The brackets fit neatly over a waratah so if the top is damaged, it will have to be filed. But a cap for protecting the top of the waratah is available. It may be easier to slip the brackets over the waratah (right way up) before driving, but take care that that the brackets are not driven into the ground too. The brackets must be fitted correctly and the insulator clips inserted properly. Then the brackets must be aligned for height, and the chain tensioned with firm blows on the bottom bracket. The chain is marked for a five-wire fence so take care to put the chain right way up if a five-wire fence is being built. The tie-downs, too, must be correctly assembled, with the stainless-steel wire threaded through from the side with the trade mark on it or it may not turn over and hold. After driving the arrowhead down, pull on the wires to

turn it over, before the tie-down is attached. The arrowhead is too soft for use in rocky country.

(c) **"Barrier":** (Multi-earth). This system appears to be simple to erect. Again, damage to the top of the waratah may cause trouble. If the insulators are kept on the outside of the chain, the brackets will be correctly fitted to the waratah.

The tie-down is much the same.

(d) **"Beattie":** These insulators can be broken so they should not be forced on to waratahs or chains too violently. Note that one side of the metal insert has a smooth edge. **All insulators must be fitted with this smooth side facing the direction the wires are to be pulled from.** This makes the pulling much easier and less galvanising will be scraped off the wire.

Once an earth wire is run out, tie-downs can be positioned and insulators threaded on for them as other wires are pulled. These insulators can be bolted to the chain later. Slotted insulators can be slipped on to the wire if additional waratahs or tie-downs are needed.

(e) **Polythene Pipe Home-made Insulators:** Lengths of pipe four to five inches long are fixed to the waratah with a tie wire about 14

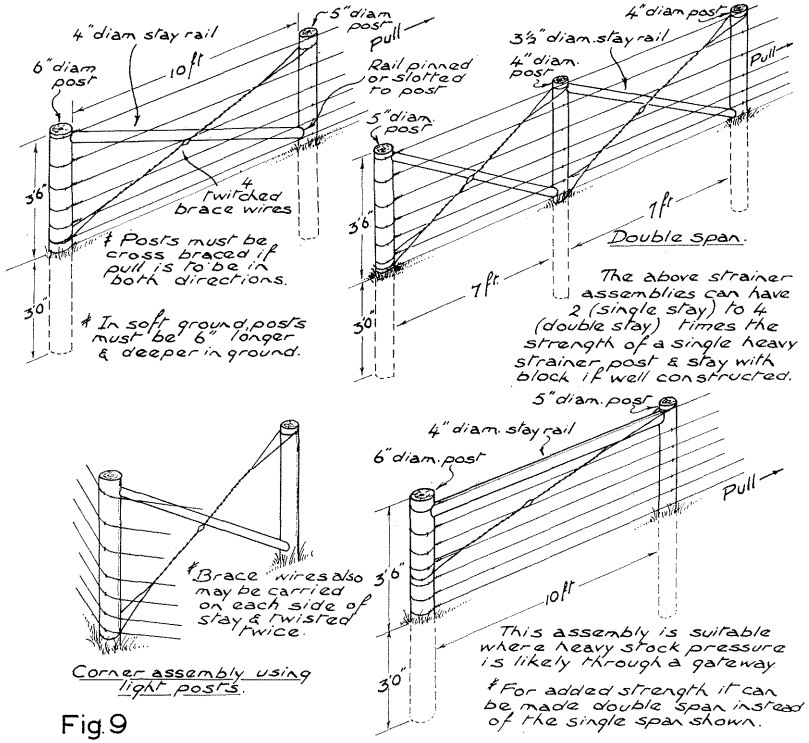


Fig. 9

STRAINER ASSEMBLIES USING LIGHT POSTS

inches long. 14 gauge lacing wire is commonly used but 12 gauge is better. The lacing wire is put through the hole in the waratah, and each end looped over the top of and crossed around the insulator. Then the ends of the wire are twitched tight behind the standard. "Williams" insulators are tied in much the same way.

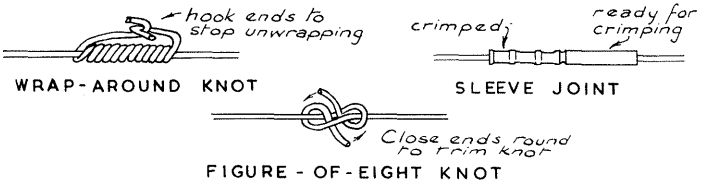
If the pipe insulators are too long, the curve of the pipe will make wire pulling harder. Insulators are easily attached to tie-down chains by crossing the wire ends over the front of the insulator then twitching them up behind the chain again. (See Fig. 3.)

High-density polythene is tougher and could have a longer life than standard polythene. It can be used for insulation at strainers and corners, if the pipe is wrapped around the back of the post. But considering that porcelain 107 insulators cost much the same, there is no special reason for using polythene.

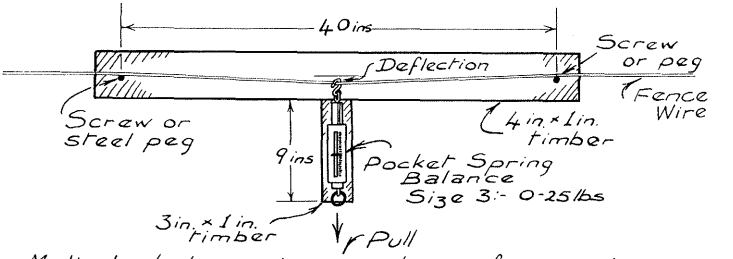
(f) **"Speedrite":** The brackets cannot be fitted wrongly and they slip over the waratah very easily. The wire must be tensioned with firm blows on the bottom bracket.

The tie-down is simple to install but is not suitable for rocky country. If a lot of force is needed to drive the plate in to the ground it will distort, and prevent the driving rod from being withdrawn.

(g) **"Williams":** Attachment to waratahs is the same as for polythene pipe. (See Fig. 3.) The improved type now on sale has a weather-proofing flap which is usually angled down, but for tie-downs must be angled upwards. They are alternatively sold with staples for posts.



KNOTS FOR 12½ GAUGE WIRE



Multiply balance reading by 20 for wire tension in lbs
Recommendations: Cold weather 400 lbs. Reading 20 lbs
Moderate temperatures 340 lbs. Reading 17 lbs
Hot weather 300 lbs Reading 15 lbs

Fig. 10. FENCE WIRE TENSION GAUGE

(h) **Porcelain:** These insulators bolt on to a waratah, a "Y", or a flat standard. Reject any with cracks or defects.

4. GATEWAYS

Details of gateways and the associated half-to-one-chain length of crush fence are shown in Fig. 8. Netting is unnecessary if the fence has six wires and waratahs are placed three yards apart in the dead section. The live wire can be carried along the top of the crush fence on cheap insulators.

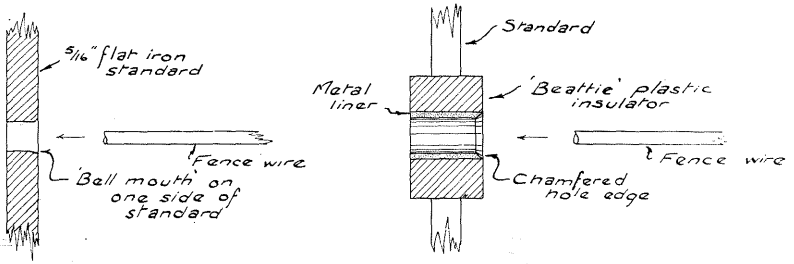
Where cattle are a problem a length of railing is a good idea beside gateways.

A cheap gate can be made from netting mounted on insulators, and livened-up. A "Taranaki" gate without barbed wire is no trouble to handle.

5. ELECTRIC CONTROLLER UNIT

This should be placed at the most accessible point on the fence line, even if this is at one end. The shock at the far end will be only slightly less than that near the unit and will be quite satisfactory if the fence is kept in good order.

If a windcharger is used, take care to select a position sheltered from the full force of the storms but exposed enough to catch all the breezes.



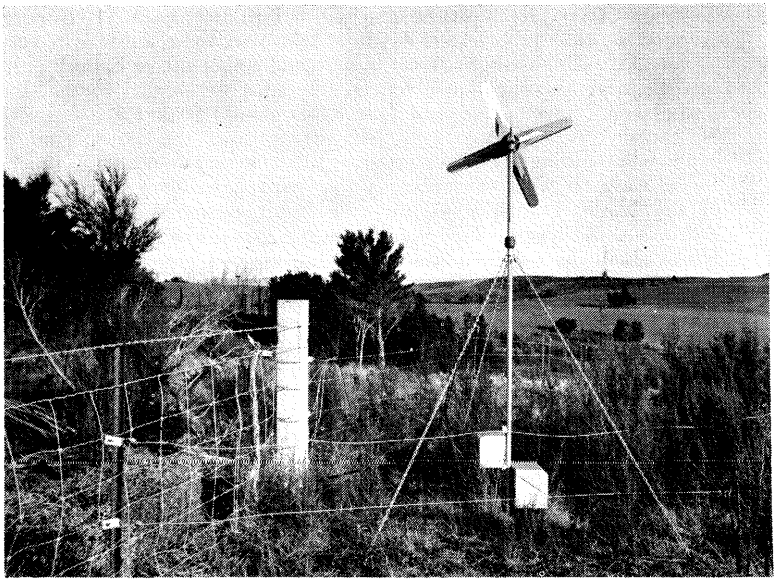
CORRECT THREADING OF GALVANISED WIRE

MAINTENANCE

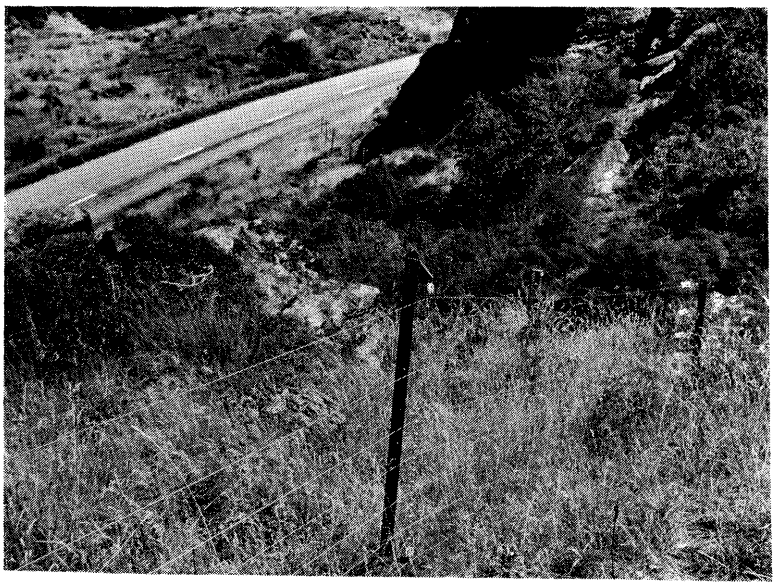
1. ELECTRICAL MAINTENANCE:

(a) **Make sure the unit is operating by checking the batteries regularly; once a month for wet batteries; once every two months with a windcharger; every six months with dry batteries, and once a month afterwards.**

(b) As soon as the fence is erected, check that the insulators are clean and all fittings are correctly installed, especially at tie-downs, where it is very easy to connect an earth wire on to a live chain with some types of fence. An insulator missing at a wooden strainer may not affect the shock until wet weather. Broken or cracked porcelain insulators should be replaced as soon as they are noticed.



A wind charger unit must be protected from stock and checked once a month.



This fence is overgrown. Only a new type "low impedance" unit will be satisfactory under such conditions. But electric fences are not recommended for roadlines.

(c) **Testing:** 400 volts must be reached before the shock is effective. A portable dial type tester, or the "Arko" six-light tester is a very useful aid. The six-light tester is designed for ordinary battery units not the new low-impedance fences. It must be shaded so that the flashes can be seen. At least four lights should flash for a fence to be satisfactory. Alternatively, the strength of the shock can be gauged by holding a long green grass blade in one hand while touching a waratah with the other. A live wire is touched with the tip of the blade, gradually pushing the hand closer to the wire and shortening the length of grass between the two. The shock should be felt at about three inches, and strongly at one inch.

(d) **If the shock is weak, check the fence for stray pieces of wire and tall green growth.** With the multi-earth system, if tall growth cannot be easily removed, **the lowest live wire can be disconnected for a time.** When servicing a fence, a short length of wire can be used to short out the fence from the earth wire to a live wire.

(2) GENERAL MAINTENANCE

The wires must be kept reasonably tight. A tension tester is illustrated in Fig. 10. One wire strainer has a tension meter fitted.

Tie-downs must be checked regularly and no tracks allowed to appear under the fence. Places where a stock track has been crossed by a fence should be watched and strengthened if any signs of stock pressure are noticed.

Extra wires can easily be added to strengthen or raise the height of electric fences with bracket assemblies. There may be only a few chains of fence requiring attention to make several miles of fence completely satisfactory.

Curves and slight bends can be taken with ordinary standards.