THE CONSTRUCTION AND USE OF A RUMINO-ELECTROMAGNET FOR SHEEP

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Summary

For the removal of steel pellets from the rumen of sheep, a powerful, low-voltage electromagnet has been developed. This is introduced and withdrawn via the oesophagus. Manipulation of the sheep tips the pellet from the reticulum into the ventral rumen sac where it is accessible to the magnet. X-ray fluoroscopy is a useful although not an essential aid.

For the removal of weakly magnetic pellets, a mechanically assisted electromagnet has been designed.

I. INTRODUCTION

Use has been made of a permanent magnet to localize "tramp iron" in the reticulum of bovines (Cooper 1954; Carroll 1955, 1956) and for the non-surgical removal of such foreign objects from this organ (Muffly 1955) in the alleviation and prevention of traumatic gastritis.

In our hands a permanent magnet has not proved satisfactory for the removal of steel pellets from the forestomachs of sheep, whereas a powerful, low-voltage electromagnet has been found well suited to this purpose.

II. THE CONSTRUCTION OF THE ELECTROMAGNET

The core of the magnet (Fig. 1) was machined from $\frac{5}{8}$ in. diameter mild steel stock, rather than built from several components in the conventional manner; this ensured rigidity of construction and reduced the possibility of the entry of fluid into the magnet coil. The coil was layer-wound over oiled silk, incorporating the cold-setting epoxy resin "Araldite" between each layer and as a tough, external insulating sheath. Enamelled copper winding wire of gauge 28 B. and S. was used. The soldered connections of the coil ends and the electrical leads were supported by a cylindrical, nylon block firmly screwed on to a threaded extension of the core. The nylon block was cemented with "Pliobond" into one end of a 5-foot length of P.V.C. tubing of 4 in. diameter and 1/ 16 in. wall thickness that surrounded the electrical leads. Lead shot (10 grams) packed inside the tubing immediately behind the nylon block provided ballast.

Activated by 12 volts D.C., this magnet is capable of supporting a block of mild steel weighing 1 ,150 grams for at least one minute without undue heating.

III. PROCEDURE

As the magnet cannot readily be introduced into the reticulum of the sheep, the removal of a steel pellet directly from this compartment by an adaptation of the method of Muffly (1955) for bovines is impracticable. It is necessary, there-

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fore, to transpose the pellet to an accessible position in the ventral rumen sac. This is achieved by manipulating the sheep as shown in Fig. 2. The new position of the pellet is best checked by X-ray fluoroscopy before proceeding.

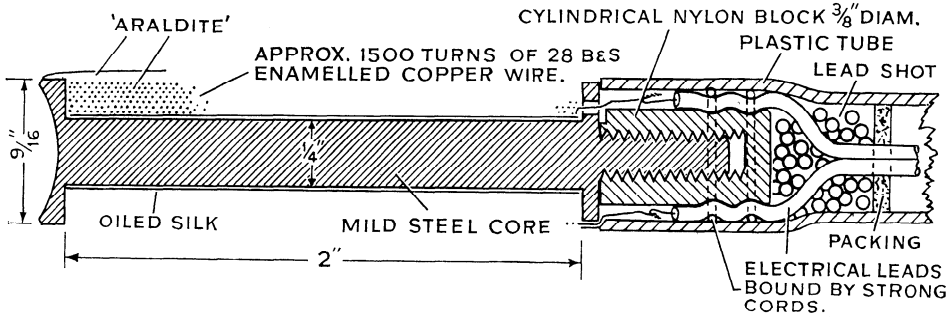

Fig. 1—Diagram of electromagnet.

A mouth gag is fitted to the animal and the well-lubricated magnet is introduced into the pharynx. As the animal swallows, firm pressure moves the magnet down the oesophagus into the rumen, which it enters horizontally. Under the influence of its own weight, the magnet describes a curved, descending path through the semi-fluid contents of the rumen into the ventral sac, approaching the floor in the central position in the vicinity of the pellet.

The current is switched on, and the successful attachment of the pellet to the magnet is checked by a brief fluoroscopic inspection; then both magnet and pellet are slowly withdrawn.

The consistency of the rumen contents markedly influences the course of the magnet entering the rumen, for the dense mass of ingesta in a fully charged rumen may deflect the magnet undesirably into the dorsal sac. Greatest success attends the procedure if the animals are previously starved, preferably for two days.

Even without the assistance of X-ray fluoroscopy, steel pellets have on many occasions been withdrawn successfully from the rumen of sheep by the procedure outlined.

IV. APPLICATION

The electromagnet described is being used in a series of observations designed to provide information concerning the factors which influence the deposition of calcium phosphate on solid objects lodged within the reticulum of sheep. In one series, steel pellets were administered to thirty Merino weaners three months old, and all pellets have been successfully withdrawn for inspection on two occasions, ten and twelve months after the initial administration. The pellets were re-administered after each inspection.

V. MECHANICALLY ASSISTED ELECTROMAGNET

For the removal of weakly-magnetic pellets, a mechanically assisted electromagnet (Fig. 3) has been constructed. Its coil is similar to that described above but, in addition, 'four pivoted, curved, stainless steel claws protrude from the free end of the magnet. These claws are opened by a spring-loaded plunger passing through the centre of the core and are closed by tension on an attached nylon cord passing through the plastic tube.

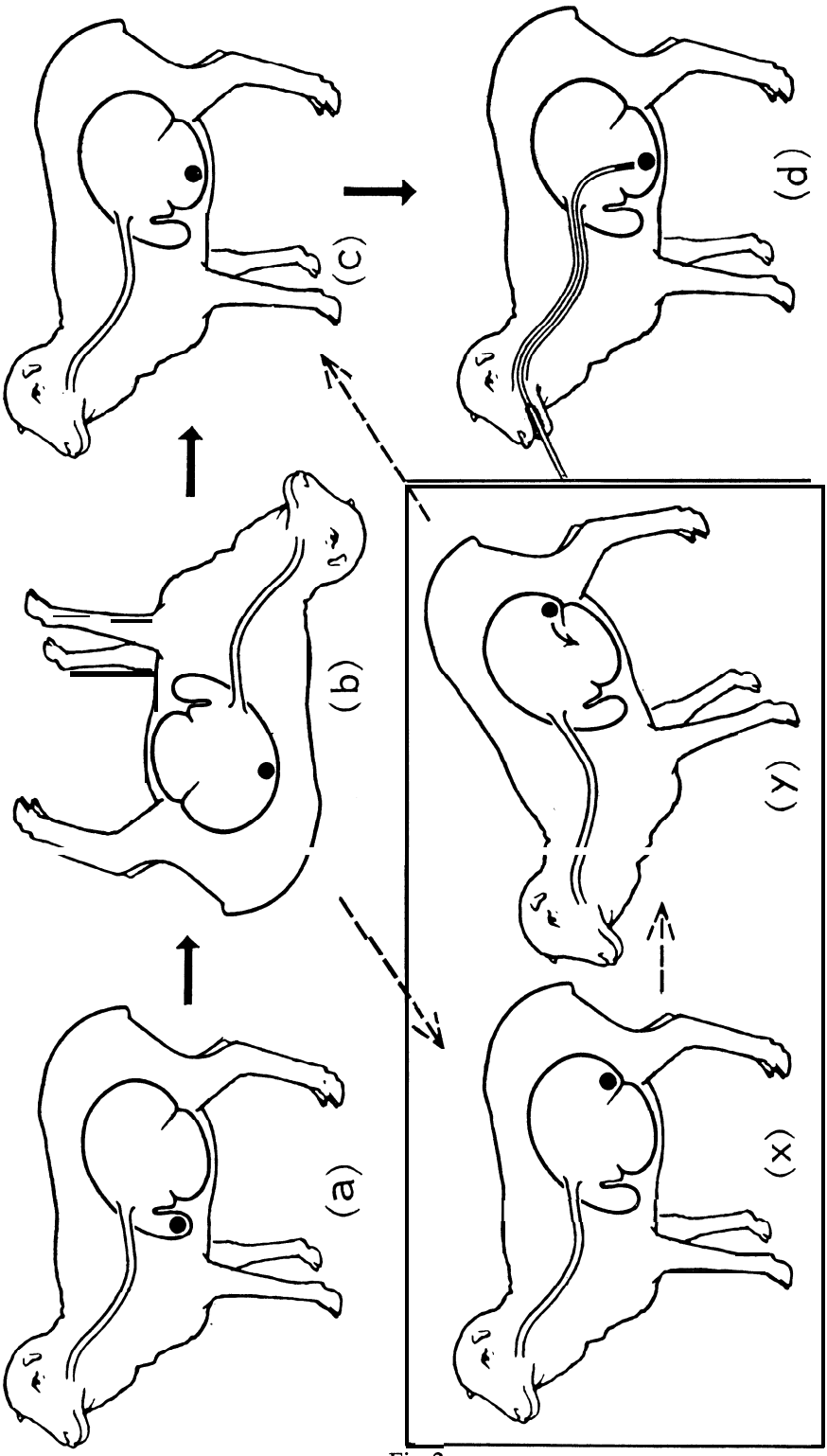

Fig. 2.

Fig. 2—Diagrammatic representation of the manipulation necessary to transfer the steel pellet from the reticulum to the floor of the ventral rumen sac.
The pellet may often be tipped from the reticulum by holding the sheep in position (b) for only a few seconds, but 3–4 minutes is necessary to ensure this in every instance. Upon righting the animal, the pellet usually falls immediately into the desired position (c) . Occasionally, however, the pellet moves from (b) to the posterior dorsal blind sac as in (x); normal ruminal contractions eventually move the pellet to the floor of the ventral rumen sac, but this may be effected promptly by raising the hindquarters as in (y). The electromagnet in close proximity to the pellet in this position is shown in (d).

When fluoroscopic inspection indicates that a pellet has become attached to the magnet, the claws are made to grasp the pellet and so prevent its detachment during removal.

It is essential that relatively few, large, solid particles be present in the rumen during this operation, as these almost invariably interfere with the free movement of the claws.

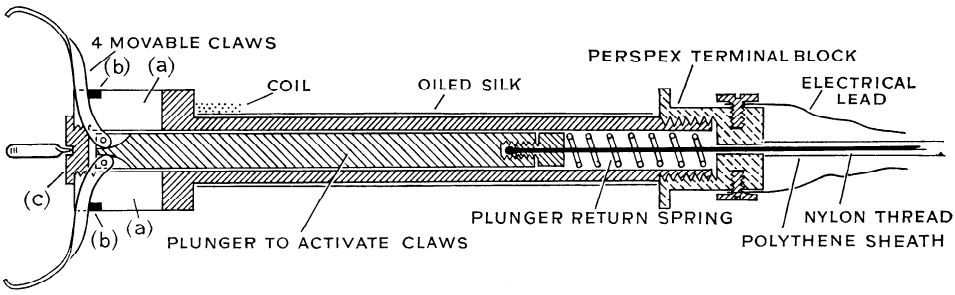

Fig. 3—Diagram of mechanically assisted electromagnet.
The movable claws operate in four longitudinal slots (a). When closing, the claws bear against a fulcrum of fine wire wound in a groove (b); and against the screw (c) when opening. One arrangement for the electrical connections is shown. The plastic tube which encases the connections, leads, etc., is not shown.

VI. REFERENCES

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