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THE MECHANISED DIRECT POTTING OF CUTTINGS

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AFRC INSTITUTE OF ENGINEERING RESEARCH

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Work carried out for :

Horticultural Development Council
18 Lavant Street
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Hants
GU32 3RW

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THE MECHANISED DIRECT POTTING OF CUTTINGS

J.B. Holt

Summary

The Horticultural Development Council, HDC, commissioned work on the mechanised planting of rooted cuttings in 3 litre pots. A mechanism was devised which would enable an operator to place cuttings in grippers which moved slowly past a work-station and which were then spaced out to the correct pitch spacing to suit a row of pots into which they could be mechanically placed. During the planting operation the grippers remain stationary. Preliminary operational trials of a rig constructed to assist with the evaluation of this system showed that a suitable number of plant grippers were presented within easy reach of a seated operator. After a few improvements the equipment could be used by a worker, accustomed to handling rooted cuttings, to determine work rates with different species.

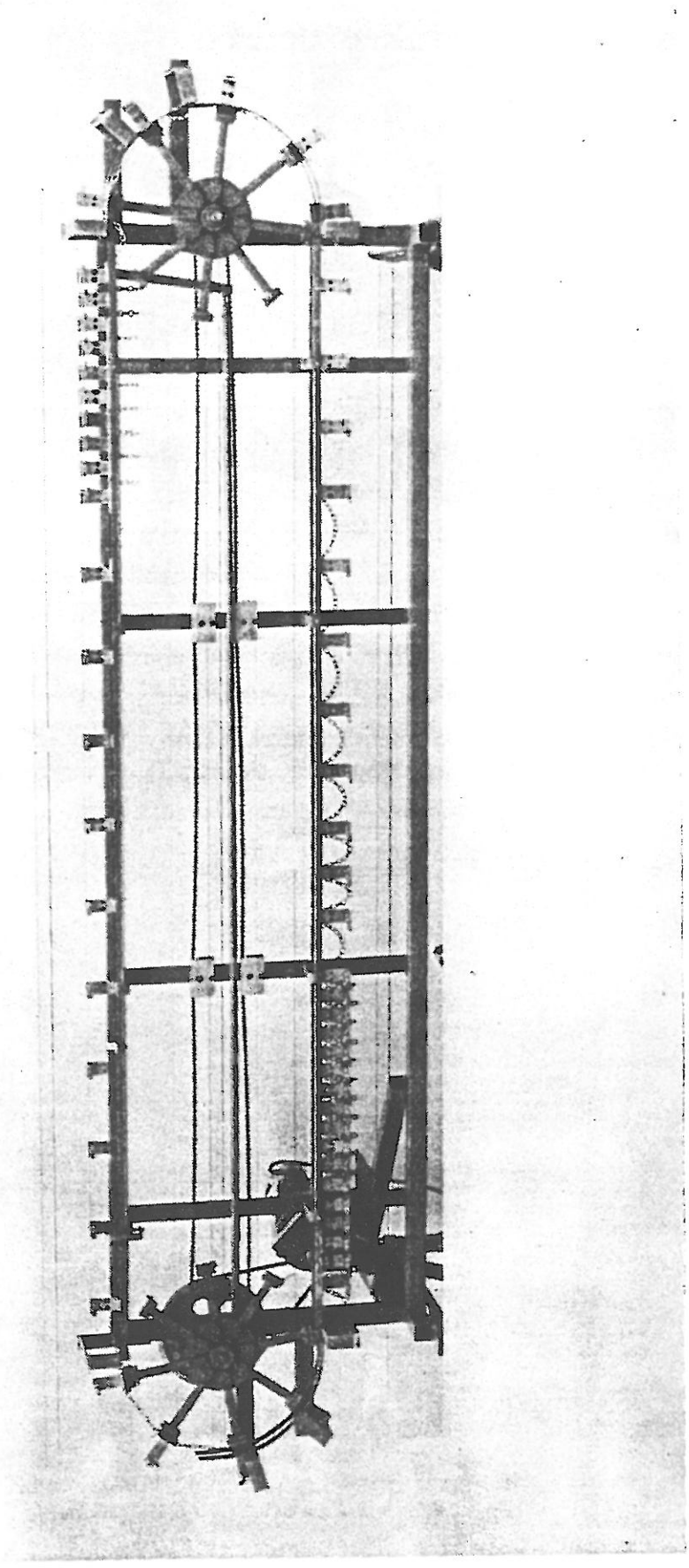

FIG 2

1. Introduction

One of the ways of growing hardy ornamental nursery stock involves planting rooted cuttings directly into pots of about the 3 litre size. Normal potting machines consist of a pot dispenser which delivers individual pots into holders on a conveyor, a compost elevating and delivery system which fills the pots with compost and re-elevates the surplus compost, and a system for drilling or forming conical holes in the compost in the pots. The operator is required to place the plants in these holes and firm the compost around them. There may be a mechanical means of transferring the finished pots from the conveyor to some other conveyor or transport unit. The general criticisms of these potting machines are that they do little other than pace the operator, roots of plants tend to be bunched together and turned up as they are placed in the holes in the compost, and much of the compost is recirculated, so its structure is likely to be damaged.

The term "direct potting" is used to describe the planting of rooted cuttings directly into large pots but this development could also apply to the planting of unrooted cuttings, although simpler apparatus would probably be more appropriate for this task.

The possibility of mechanising the planting of rooted cuttings was recognised by the HDC Hardy Nursery Stock Panel as a result of seeing the Institute's work on the mechanised repotting of liners (plants in 7 or 9cm pots) into 3 litre pots. They wished the Institute to investigate whether an additional module could be developed which could make use of the compost delivery system, the potting process and the large pot handling facility of that equipment, fig 1.

2. The operating principles of the new system

The perceived requirement was to enable an operator to sort cuttings and place the good ones in receptacles or grippers at a variable rate. The plants should be presented at the mechanised potting position in groups suitably spread apart and should be held stationary while the potting process takes place. In order that the operator can maintain an acceptable rate of work, the receptacles or grippers must be at a convenient height and must be fairly close together so that at any time a number are within easy reach. To suit the spacing of the 3 litre pots in the existing AFRC Engineering repotting machine the plant holders need to be at 210mm pitch spacing.

To meet these requirements a conveyor in the form of a variable pitch "chain" has been devised consisting of sliders linked in such a way that they can be pushed together to provide a 50mm pitch spacing, or drawn apart to 210mm spacing. The drive arrangement to the conveyor causes the sliders to move continuously at slow speed through the operator's zone but intermittently through the potting area. A plant gripping mechanism is fitted to each of the sliders.

As with the repotting machine, the potting operation would be performed simultaneously on a number of plants, eight at a time in the case of the repotting machine but possibly more for direct potting. Having been moved into the potting area the group of plant holders would remain stationary while the pots were raised or the conveyor was lowered, compost would be delivered around the plant and the plant grippers would be opened as tamping took place. The finished pots would then be conveyed away.

While this potting operation was taking place, other plant holders would continue to move slowly in front of the operator.

3. The trial equipment

As the concept was original it was difficult to predict whether it would be effective in enabling an operator to achieve a greater rate of work of a consistently good standard than is achieved at present. It was far from clear as to what would be a reasonable operating speed over a period of perhaps an hour, and whether the operator would be able to perform some effective grading of the cuttings.

The time scale and the amount of resources available precluded the design and construction of a succession of laboratory rigs to test and develop separately the various features of the concept, so a decision was made to construct one working rig to illustrate the basic principles. Although this rig would not be linked to the repotting machine, it would allow a worker to place cuttings in the holders and it was scaled to match the eight-pot-at-a-time repotting machine.

The bench-top rig, fig 2, has an overall length of about 3.6 m and is driven by a variable speed motor and gearbox borrowed from other equipment.

The conveyor is shown diagrammatically in fig 3 which indicates, approximately to scale, the movement of the plant grippers (represented by dots). The way in which the variable pitch conveyor is caused to provide continuous movement of the plant carriers past the operator, with the carriers conveniently close together so as to provide a buffer between the operator and the potting operation, and the intermittent movement for the latter operation, is shown in fig 4. The left hand shaft A is driven continuously by an electric motor and a variable ratio transmission. The eight armed "sprocket" fixed to this shaft pushes plant carriers continuously through the operator's work zone. A sprocket B also attached to this shaft drives a sprocket C at twice the speed of B.

An arm secured to C carries a pawl P which can engage with the lug L on the hub H which is freely mounted concentrically with

sprocket C. A cam D attached to sprocket B operates a push rod R which causes the pawl P to be deflected for part of every revolution of shaft A causing the pawl to disengage with lug L. In this way the right hand hub carrying the eight "sprocket" arms is caused to make one revolution and then miss one revolution for each revolution of the left hand conveyor drive "sprocket".

The ratio of the dwell time to the time while the carriers are moving through the potting zone (and round the right hand "sprocket") is 1:1.

A plant carrier is shown in fig 5. Its bracket is attached at T to a 50 x 50 mm block of plastic which slides in plastic guide channels. The grippers G are designed to accommodate a range of stem thicknesses and the gripping force exerted by the torsion spring S can be adjusted by hooking its anchored end into a different anchor hole. The release lever R, fig 6, is provided to open the gripper when the cutting has been planted and was designed so that a row of (eight) such units could be opened simultaneously by the movement of a bar extending the length of the potting possition. In the rig the plant carriers are connected together by lengths of welded wire link chain but prestretched cord or flexible multi-strand wire could have been used.

4. Performance

Using the variable speed drive unit the equipment has been run at a range of speed likely to cover the practical working range. Some further work on the equipment is needed to make it suitable for extended operation handling cuttings. About eighteen plant grippers are positioned 50 mm apart within easy reach of a seated operator and the movement of these, although slightly jerky, looks to be acceptable.

Trials with a worker familiar with handling rooted cuttings would be necessary in order to determine the level of acceptability and the work rates achievable with different plant species, and extent of growth. It would also be useful to determine what the work rates were when the operator was using pregraded plant material, or when having to grade it at the same time. This latter slightly more demanding task might be more acceptable to many workers.

5. Conclusion

Equipment has been devised and constructed which successfully demonstrates the idea of a conveyour which allows an operat or to place rooted cuttings in holders which are conveniently spaced for that operation, and which transports those cuttings to another position where they remain stationary for a few seconds while mechanical potting could take place. The equipment is envisaged as making use of some of the components of, or the technology developed for, the automatic repotting machine being developed by the AFRC Institute of Engineering Research. Trials would now be appropriate to determine the likely performance of an operator using the system.

A matching mechanised potting module could then be designed and tested.

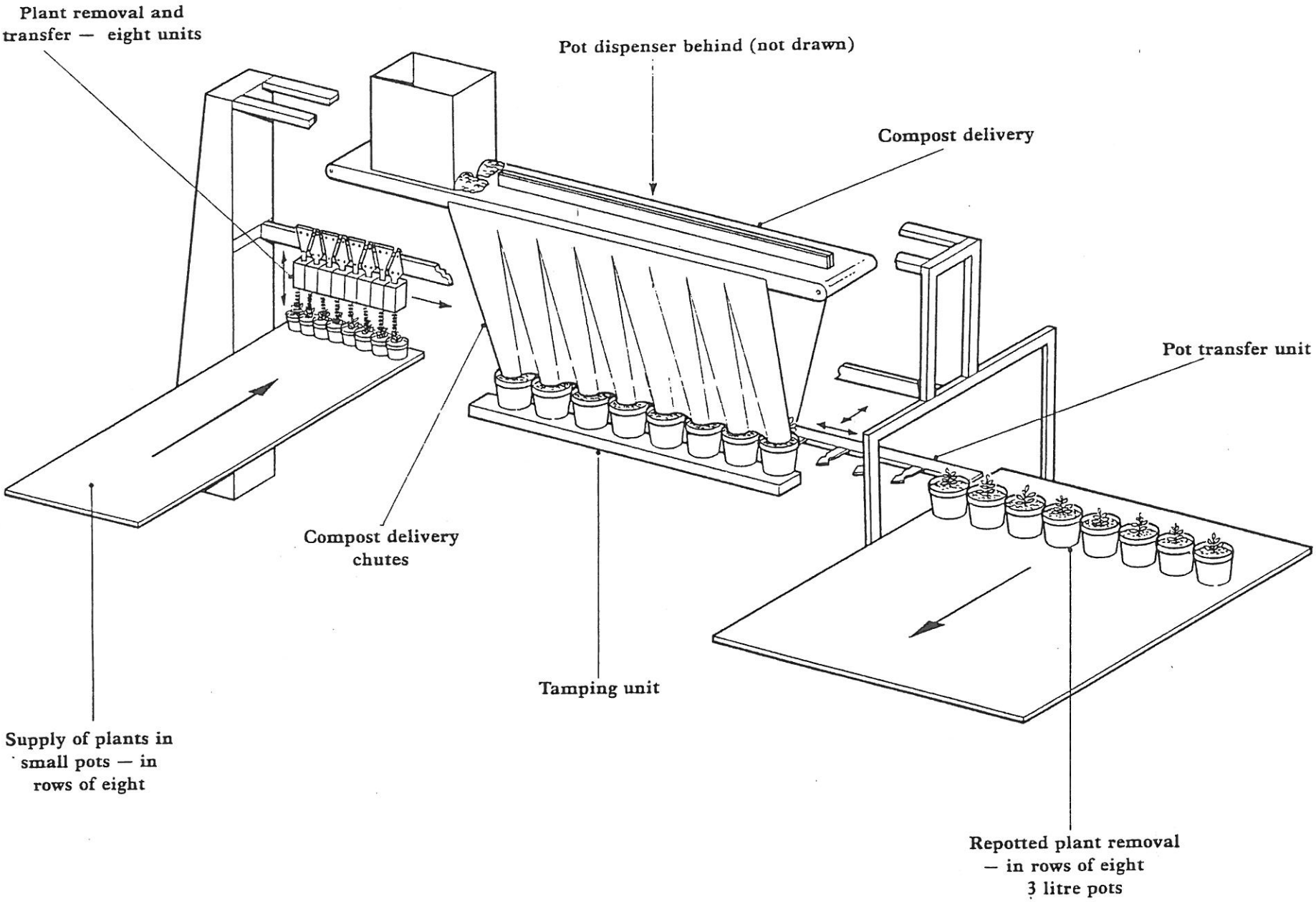
Plant removal and transfer — eight units
Pot dispenser behind (not drawn)
Compost delivery
Pot transfer unit
Compost delivery chutes
Tamping unit
Supply of plants in small pots — in rows of eight
Repotted plant removal — in rows of eight 3 litre pots

FIG 1

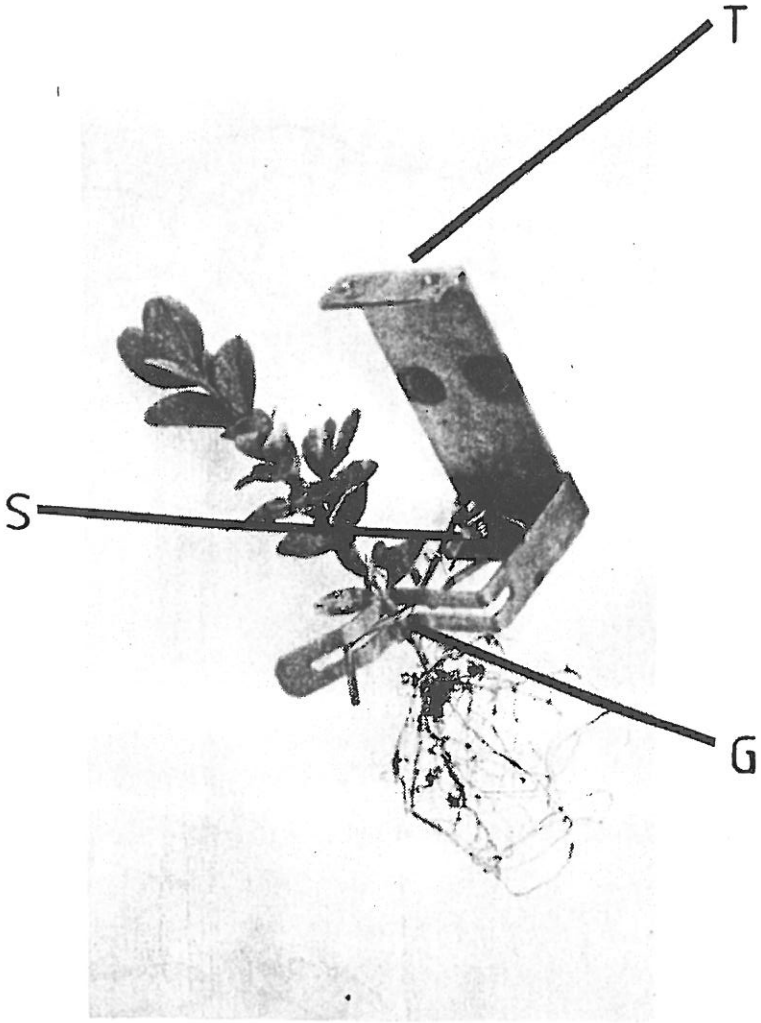

FIG 5

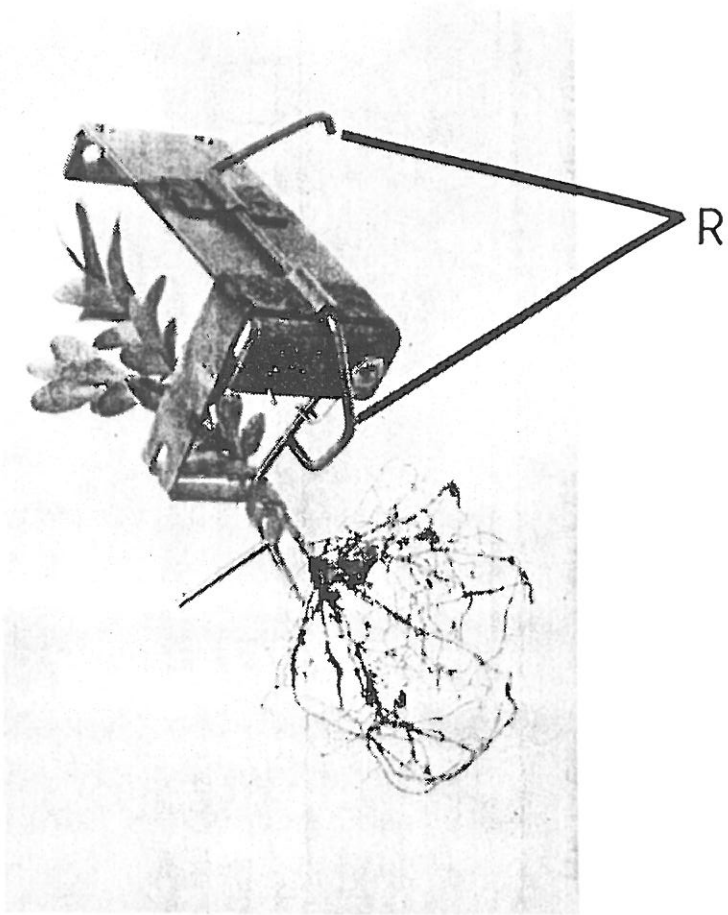

FIG 6

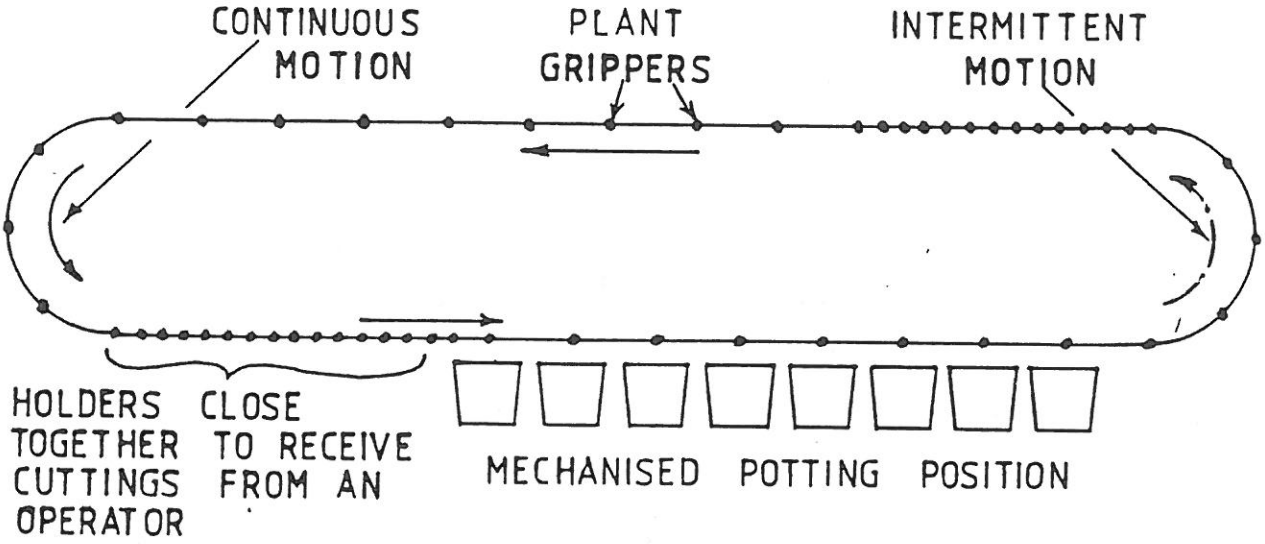
CONTINUOUS MOTION
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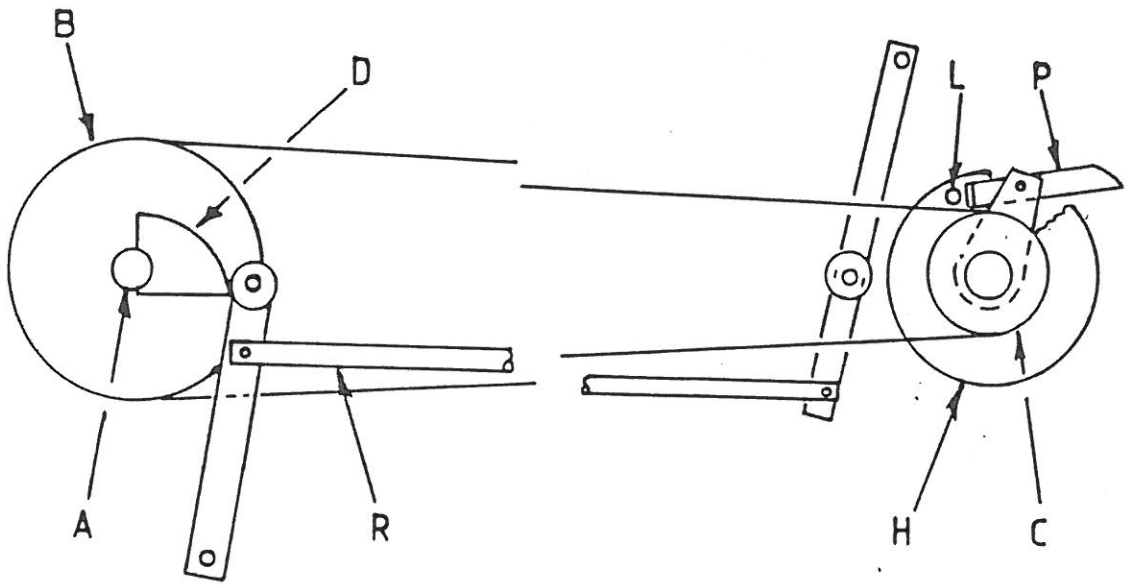
FIG 3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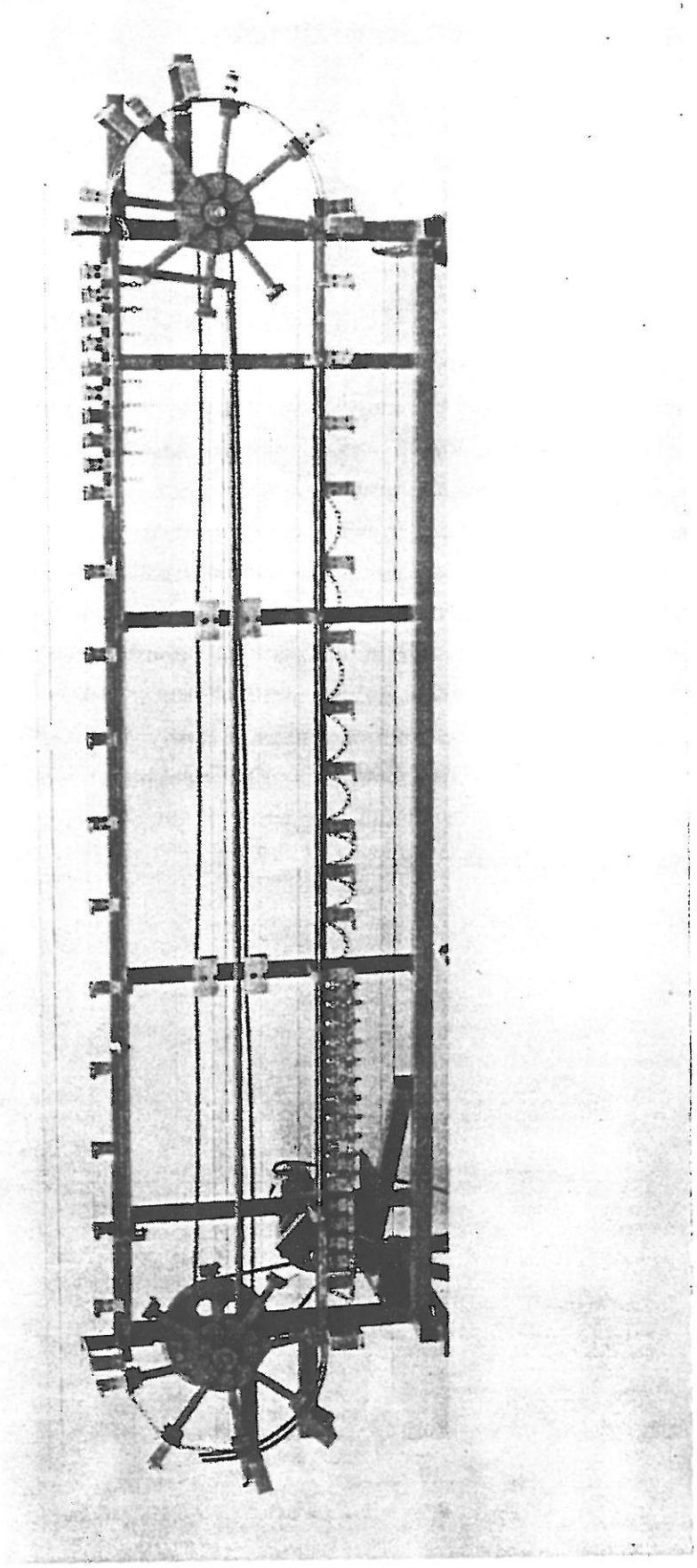

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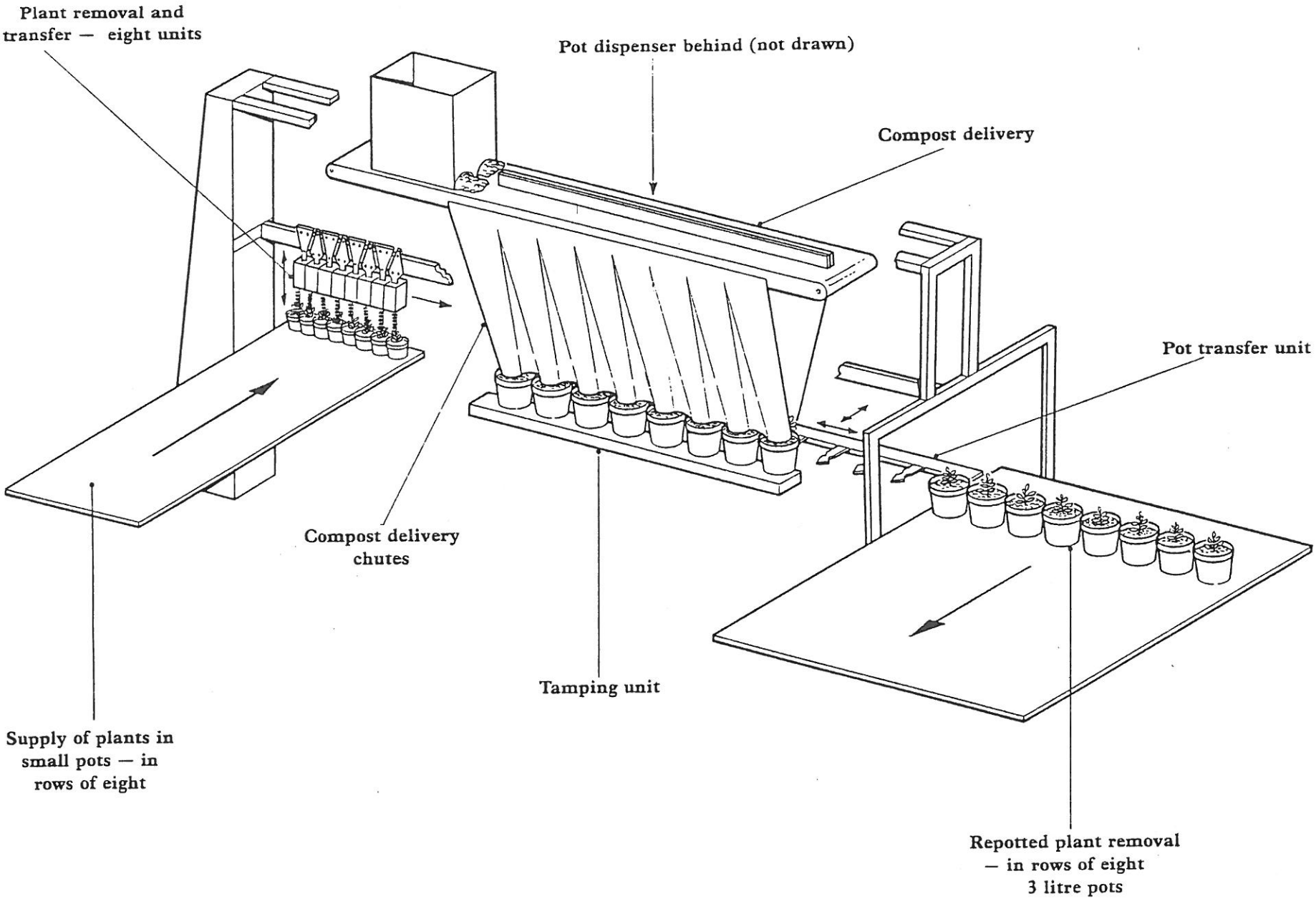
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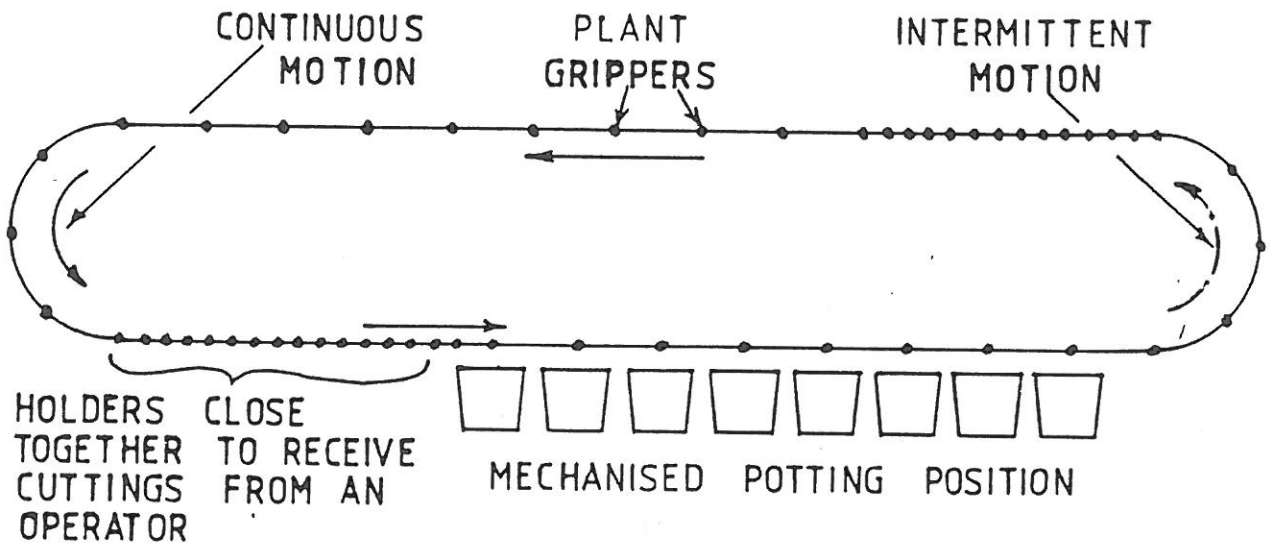
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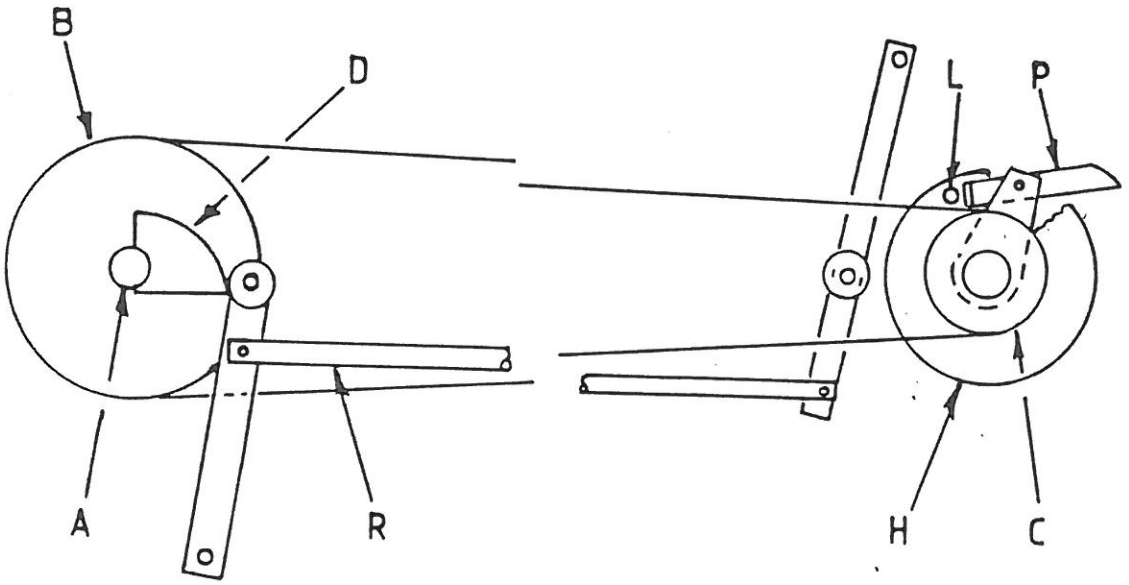
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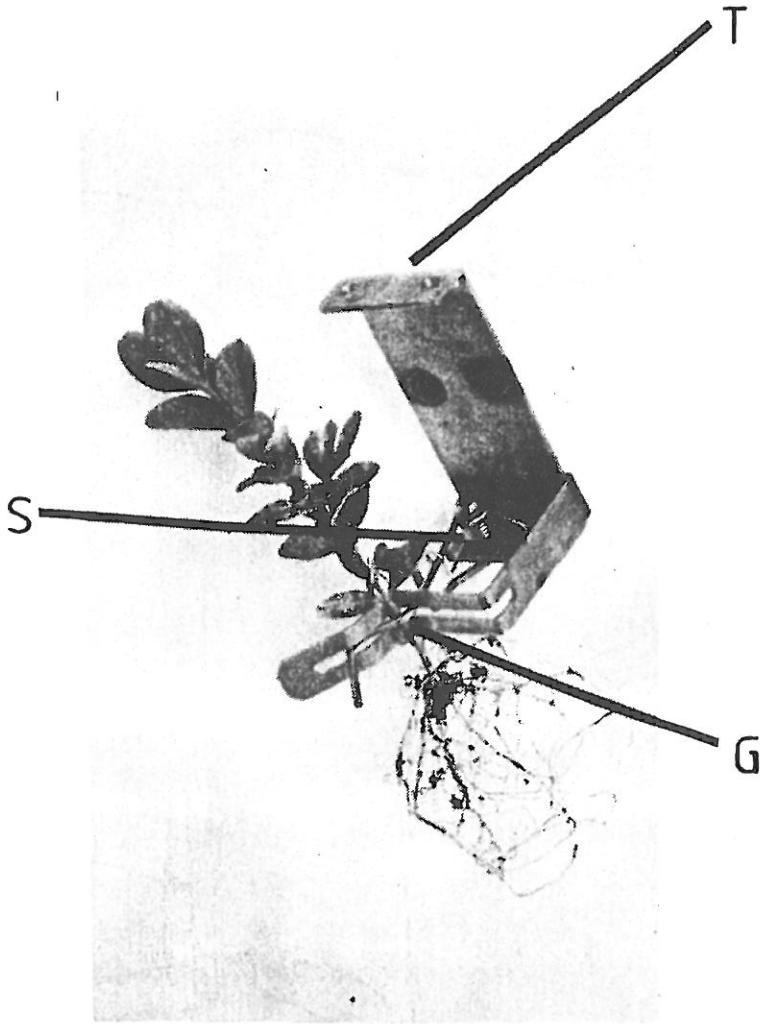

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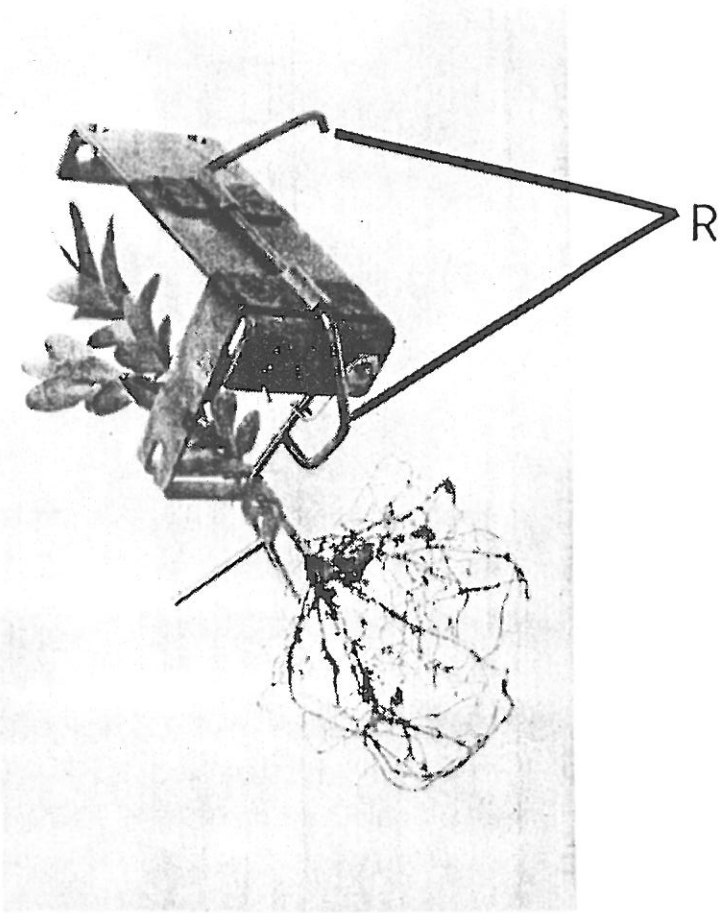

FIG 6

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The Mechanised Direct Potting of Cuttings

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