

PATENT SPECIFICATION

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(54) IMPROVEMENTS RELATING TO THE GROWING OF SEEDLINGS

(71) I, HENRY ANDERSON SPENCER of 8005—137 Street, Edmonton, Alberta, Canada, a Canadian citizen, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to containers for raising plants for transplantation, and particularly to improvements in containers which provide a container planting system superior to other known systems, and which provides an adaptability not found in other plant container systems.

Horticulture and forestry practices recently have undergone changes in techniques. Industrial ideas have been applied to these practices to make the two disciplines more efficient than in the past. Standardization of product, mass handling systems, and a "product engineering" approach to growing plants has resulted. Among the systems now practised is one known as "Container Planting", where a plant is kept in a standard container, not unlike a flower pot, and is protected during the critical stages in its early growth. The container is used throughout all the rearing stages, before final transplanting occurs, and this would include seeding and/or placing a cutting into a container.

Man has long recognized the need to replace forests, and reforestation has been extensively practised in many areas. Reforestation has been carried out by a number of different methods, including:

(1) the natural method, whereby a forested area is allowed to regenerate itself; and

(2) the nursery method.

The natural method of reforestation, as will be appreciated, is haphazard.

Nurseries were the first step in meeting some of the demand for new trees. In the nursery method of reforestation seed is collected, prepared, sowed in long narrow beds in as dense concentration as possible,

and covered with mulch; the beds are watered and the seedlings tended as they germinate, sprout and begin to grow. Two years later, when the seedlings are three to five inches high, they are dug up, the unpromising ones are culled, and the seedlings are transplanted by machine into other beds, and spaced out to allow further growth. After a further two years, the seedlings are considered strong enough to stand transplanting at their final site, and are then uprooted again and moved out to the forest. This method still is used; however, it has been at least partially supplanted by a newer method, container planting.

Largely as a result of the needs of reforestation programme, a good deal of work has been carried out in recent years to develop improved methods and equipment for growing and planting seedlings. One promising method, with which this invention is concerned, is known as container planting, and this method has become a useful addition to the nurseryman's techniques. The time-honoured method of raising seedlings in a nursery bed has some disadvantages, notably the lack of control over disease, the damage to seedlings from pests and weather, and the tendency of certain tree varieties to send out long roots which would need to be pruned before the tree could be removed, transported, and transplanted. Such pruning has often set back a seedling's growth or caused deformation and weakening of the root system.

The "container" method involves providing a large number of cell-defining containers. The containers are filled with a growing medium, such as peat moss, and a seed is planted in each cell. After covering with grit or mulch, the seeds are permitted to germinate, and after they begin to grow, the young seedlings may be kept in a greenhouse from 4 weeks to 8 months depending on the variety and on the available environmental control. At this

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point, the seedlings may be set out into a shaded area to acclimatize them to normal conditions before being transplanted. In some cases, a dormant condition is desired for transplanting, so the young seedlings may be specially treated with fertilizers, or in addition may be slowly cooled. In the planting season, the seedlings are transported to the planting site directly in their containers, and kept in them for as long a time as possible. The planting operation is commonly carried out by a three man crew. One of the crew carries the containers and distributes them to the other two; these men, the planters, each form cavities in the soil with a dibble stick, extract the seedlings and attached root balls from the cells and tamp them into the cavities.

A good container is one of the keys to the success of this system. In the greenhouse stage, the container should provide cells which foster the development of a thick system of roots. Without a good root structure, the plant will usually not survive in the field. For the purposes of the planting stage, the container should be a compact article which can be easily handled by the planters and which is adapted to permit efficient extraction of the seedling and root ball in an undamaged condition from the cell.

Advantages of container planting are as follows:

1. Each seedling is given an individual, non-competitive, controlled environment in which to grow and develop.
2. Seedling production-seeding, thinning, weeding, atmosphere, fertilization, light control, temperature regulation and above all, handling, can be mechanized.
3. Seedlings are not "shocked" by transplanting, since they are in individual "pots" and the roots do not get damaged during this mechanical operation.
4. Because the seedlings will not be "shocked" they may be transplanted during summer months on a regular, weekly or daily basis. High productivity of labour and facilities, high survival rates and tangible good results are realized.

The prior art containers used in reforestation projects can be classified into two broad groups. The first group comprises plastics tray or blocks having rows of separate, tapered cells formed in them. To extract the seedling and root bulb from this type of cell, one grasps the seedling, at a time when the peat moss has become root bound, and simply pulls it out. A problem with this type of tray is that the time when the ball is root bound dictates when planting can be carried out. Another disadvantage is that the trays are quite

bulky and relatively large quantities of plastics material are used in making them. The second group of containers comprises a single cell unit, such as a paper or plastics cylinder. Most containers of this type are buried in the soil together with the root ball, and seedling. Because the only egress available to the roots is straight down through the open end of the container, there is initially little lateral growth of the roots. As a result, the plant is not well anchored during its early development; this leads to poor growth and a high mortality rate due to causes such as frost heaving. Another defect of this type of container is that the amount of labour required to handle large numbers of individual, separate cells is higher than is the case with multiple-cell units.

A distinct drawback to the use of the above type of planting container, which is intended to be allowed to degrade and is therefore left in the ground, is that the soil bacteria, the temperature, and generally the climate, must be just right or else the degradation of the container will take place too slowly, causing problems with root entrapment and deformation of the transplanted seedling.

Container Planting involves the use of environmental control during germination and early growth, providing healthy plants with a good chance of survival after transplanting, and specifically allows tree seedlings to grow in individual cells. A problem with many varieties of plant containers has been their need to have long and deep cells for handling tap-root development or to enable the transplanted seedling to reach a low water table. Ordinary pots or deep cells of this kind do not allow easy removal of the seedlings for transplanting until the whole volume has been filled with roots. Since such root-binding is undesirable horticulturally, it is useful to have an easy method of withdrawal, which allows the whole plug of roots and soil medium to be handled without damage and to be placed without any restrictive covering into the transplanting site.

The present invention provides the above advantage, and also allows for easy inspection of root development without disturbing the root system or straining the stem or trunk of the seedling. It is either a folding planter or one made in two halves, single or multiple, which can be removed from a box and opened easily, without restriction, along an axial split to reveal the root system for examination or easy removal for planting or culling. The same container(s) and plant(s) may then be closed and replaced in the box, which in turn hold the two sides together in each

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container. A shiplap joint is provided which provides a long and difficult path for probing roots to traverse and escape into adjoining containers.
5 Within the walls of the container(s) of this invention and formed into the sides are longitudinal grooves, which catch and hold roots as they develop, and prevent roots from spiralling, which is the roots' natural tendency when they reach a smooth-walled surface. At the bottom of the container(s) the growing medium must be supported, yet as large as possible an opening is maintained to provide space for developing roots. In practice, roots are allowed to emerge from the bottom of the container(s) but are prevented from growing much further by circulation of air under the container(s). The grooves are able to direct outside roots straight toward this opening, and since the roots in them are also straight, these roots become end-withered quickly. As the plant has certain root-promoting qualities which are frustrated by this, it throws out branches of roots which repeat the process.
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It is therefore an object of this invention to provide a container whose structure is adapted to direct root growth to an air-pruning aperture to promote the growth of a thick root system having relatively straight roots.
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According to the invention, in a first aspect thereof, a container for growing seedlings, said container being normally upstanding when in use, comprises: a pair of opposed first and second wall members, each formed of flexible, substantially non-porous sheet plastics material, each said wall member being formed by a series of spaced, inwardly-projecting, elongate shoulders integrally joined by webs, the shoulders of the first wall member being mutually opposed relative to the shoulders of the second wall member, said mutually-opposed shoulders being provided with interengaging means, whereby when the wall members are pressed together, a series of open-topped cells are formed, defined by the shoulders and their connecting webs and closed along the greatest part of their length; the lower end portions of each pair of opposed webs and integrally-joined shoulders combining to form the base of each cell, within which is formed an aperture, said webs constituting the predominant portion of the side walls of the container, and each pair of opposed webs forming the side wall of an individual cell of said series of cells; each said web having root directing grooves longitudinally of said cell, the grooves in the interior side walls of each said cell extending downwardly toward the base aperture for directing root growth toward said aperture.
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According to the invention, in a second aspect thereof, there is provided in combination:
(a) a plurality of upstanding containers for growing seedlings, each said container comprising a pair of opposed first and second wall members, each formed of substantially non-porous sheet plastics material, each said wall member being formed by a series of spaced, inwardly-projecting, elongate shoulders integrally joined by webs, the shoulders of the first wall member being mutually opposed relative to the shoulders of the second wall member, said mutually-opposed shoulders being provided with inter-engaging means, whereby when the wall members are pressed together, a series of open-topped cells are formed, defined by the shoulders and their connecting webs and closed along the greatest part of their length; the lower end portions of each pair of opposed webs and integrally-joined shoulders combining to form the base of each cell, within which is formed an aperture, said webs constituting the predominant portion of the side wall of the container, and each pair of opposed webs forming the side walls of an individual cell of said series of cells; each said web having root directing grooves longitudinally of said cell, the grooves in the interior side walls of each said cell extending downwardly toward the base aperture for directing root growth toward said aperture; and
(b) a holder for said containers, said holder having side and end walls and a flat, foraminous bottom for retaining growing medium in the cells, said containers being disposed in abutting relationship with respect to each other and to the walls of the holder, said containers being so arranged as to fill said holder.
By use of the container according to the present invention, the roots of a seedling grow laterally out to the container side wall and then follow the root grooves down to the aperture—on contacting air, which is of course devoid of nutrients, the roots wither, with the result that new roots sprout, thereby developing a thick root system.
The container is preferably hinged along its bottom edges to that it can be opened to expose the contents of its two halves. To extract the seedling from one of the cells, the planter opens the container and holds it in the palm of one of his hands, as one would do with a book, or places it in a carrying pouch, and uses his other hand to gently pry the exposed root ball free. At the same time, he may flex the thin-walled, flexible sheet plastics container to aid in releasing the root ball. In the greenhouse, the containers are tightly packed together in rows in a tray or box; the walls of the tray
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or box act to hold the containers closed. The structure of the container is such that it can be formed from a single, thin sheet of plastics the consumption of raw material in manufacturing it is therefore kept in a minimum.

For mass production, it is more economical to have the containers in ganged and hinged "books" which are held closed within the confines of a foraminous-bottomed box. Several variations of this version with and without the hinges are possible. For individual plant sales or for such applications as when the grower may wish to keep individual plants separate, a tube-like container may be provided with most of the above-mentioned specific features which are improvements to container planting, and in addition some other features especially suited to the individual container.

A common feature of these containers is the form of the side walls of the container, which contain multiple grooves or flutes (more than four) which extend throughout the full effective length of the container to direct roots to the opening at the bottom. When filled with a growing medium, plants grow roots in each container, which roots are directly channeled toward the bottom by being trapped in these grooves or between ridges of the flutes. By the term "effective length", is meant that part of the container which contains the growing medium.

Another common feature of these containers is their possible combination with a box or tray which holds them in a satisfactory position for filling, the box or tray having a foraminous bottom which will not allow the growing medium to fall through (but will allow the roots to penetrate and be air pruned) and preventing the folding "books" from coming open.

Another common feature of these containers is their substantially constant cross-section throughout their effective length, which gives the roots as much unrestricted volume as possible, and assists in maintaining a tight pack of containers for vibration filling, the box or tray being the holding fixture with vertical parallel sides, and the containers being fitted tightly into the box.

A specific feature of the folding ganged container is its hinged design, which allows the ganged container (when removed from the holding box or tray) to be opened and closed like a book so that the progress of growth may be studied. In early development of the plants, during climatic changes which provide more or less humidity and more or less heat, development of the plant may not match

the fertilizer regimen that has been chosen. In a case for example, where fertilizer has built up and salts have collected in the containers, the roots may rot out, unless the excess fertilizer is leached through by plain water. Such conditions are not easy to discern unless the state of the roots can be inspected. In other containers, it is difficult to remove the "plug" of growing medium without damaging the root structure. Hence it is important to be able to open the container on a hinge and to close it up again without disturbing the plant.

For a more detailed description of the invention, reference will now be made to the accompanying drawings which illustrate various aspects of the present invention by way of example, and wherein:

Figure 1 is a perspective view of one form of the container in the open position;

Figure 2 is a plan view from above of the container illustrated in Fig. 1;

Figure 3 is an end view of the container of Fig. 1 in the open position;

Figure 4 is a side view of half of the container of Fig. 1;

Figure 5 is a top view of the container of Fig. 1 in the closed position

Figure 6 is a plan view from below of the container of Fig. 1 in the closed position;

Figure 7 is a top plan view of an alternative embodiment of the container in an open, flat position;

Figure 8 is a top plan view of one side wall of the container shown in Figure 7;

Figure 9 is a side view of one end of the container shown in Figure 7;

Figure 10 is a partly cut away perspective view of the container of Figure 7 in the closed position;

Figure 11 is a perspective, partly broken-away view of an alternative embodiment of the container in the closed position;

Figure 12 is a perspective view of a single cell member, similar to those shown in ganged arrangement in Figure 11, in the open position;

Figure 13 is a perspective view, partly broken-away showing a container comprising separate wall members;

Figure 14 is a perspective view of a container similar to that shown in Figure 11, disposed in a box having a grid bottom; and

Figure 15 is a pictorial representation, in perspective, of a typical growing seedling showing the root pattern developed by the use of the container of this invention.

Referring now to Figures 1-6, the container 11 illustrated includes a pair of upstanding, opposed, generally rectangular wall members 2, 3 hinged along their bottom edges by the horizontal, rectangular hinge member 4. The wall and hinge members 2, 3, 4 are formed from a single,

4	thin-walled, flexible, non-porous plastics sheet so as to provide a unit comprised of three integral parts.	protrude out of the growing medium and contact air, they wither at their ends, thus is called "air-pruning". The seedling then sprouts more roots and the sequence is repeated. In this way, a thick growth of relatively straight roots is gradually developed. The roots of each seedling are prevented by the combination of the shoulder edges 12 and indentations 13 from extending into the next cell. As a result, the roots of adjoining seedlings do not become entangled with each other. When the seedlings are to be planted, the closed containers are packed in trays or boxes and carried into the fields. There each container is opened to expose the seedling and its root ball. These are extracted in the manner previously described and the empty container is retained for re-use.	70
5	Each wall member 3, 2 comprises a series of spaced, inwardly projecting, elongate shoulders 5, 6 joined by curved webs 7, 8 respectively. The shoulders 5, 6 and webs 7, 8 combine to define two rows of parallel, open-topped, inwardly opening, downwardly extending grooves 9, 10 of semi-circular cross section. The shoulders 5 of the wall member 3 are mutually opposed relative to the shoulders 6 of the wall member 2 whereby, when the container 1 is closed, they combine to define a row of separate compartments or cells 11.	According to one method of manufacture, the container is thermoformed from .010 inch thick, base stock, high impact polystyrene. This plastics strip is indexed into a hydraulic press having a perforated, heated platen which is equipped with a sealing ring circumscribing its working face. The press forces the plastics material against a corresponding ring on the mould side, thereby sealing the working area of the plastics material. The mould is suitably perforated to allow for the passage of air. The plastics material is pre-stretched and forced by air fed through the mould against the heated platen, which has a vacuum applied against its non-working side. A vacuum is then applied to the non-working side of the mould, and air is passed through the platen to force the plastics material onto the mould where it cools to a rigid state. The press then opens and the plastics material is lifted off the mould and conveyed into a punch press. The necessary holes are punched and parts cut out, except for connecting tabs, by the press. The material is then moved to a cut-off knife and the units are separated.	75
10	In a preferred feature, the shoulders 6 have pointed edges 12 and the shoulders 5 have indentations 13. When the wall members 2, 3 are pressed together, the edges 12 seat in the indentations 13 to provide tight, lengthwise seals between adjoining cells.		80
15	The shoulders 5, 6 and webs 7, 8 are flared and curved, respectively, to provide gathered portions 14, 15 at the bases of the grooves 9, 10. Semi-circular apertures 16, 17 are formed in the gathered portions 14, 15. When the container 1 is closed, the apertures 16, 17 unite to form apertures 30 for drainage and air pruning.		85
20	One or more inwardly opening, longitudinal root grooves 18, 19 are formed in the webs 7, 8. These grooves 18, 19 lead down to the base apertures 16, 17 and serve to direct root growth in that direction.		90
25	Adjacent the upper ends of some of the shoulders 5, 6 tapered sockets 20 are formed, lugs 21 extend from the opposed shoulders so as to frictionally engage the sockets 20 when the container 1 is closed. These elements combine to hold the container 1 closed under most circumstances and prevent the wall members 2, 3 moving vertically relative to one another.		95
30	Turning to hinge member 4, a series of openings 22 which correspond with the apertures 30, are provided. In addition, the hinge member 4 is formed to provide a series of downwardly extending lugs 23. These lugs 23 serve to elevate the container 1 above the tray floor (not shown) so that roots protrude through the apertures 30 and 22 for pruning.		100
35	In use, a number of the containers 1 are stacked together in a closed, upstanding position in a tray or box having a formious bottom. Peat moss or other suitable growing medium is packed into the cells 11, and a seed is planted in each. With watering, the seed germinates and grows into a seedling. As its roots lengthen, they are guided downward by the grooves 18, 19 to the apertures 30. When the roots		105
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of Fig. 7 to define the indentations 56. The indentations 55, 56 terminate short of the upper ends of the shoulders 53, 54. Short indentations 57, 58 are formed in the left and right hand edges when viewed from the right of Fig. 7, respectively of the shoulders 53, 54. It is to be noted that the shoulders 53, 54 of wall 51 are mutually opposed to the shoulders 54, 53 respectively of wall 52. As a result, the non-rebated portions 59, 60 of shoulders 53, 54 seat in the indentations 58, 57 of shoulders 54, 53 when the walls 51, 52 are in the closed position to provide shiplap joints. An interlocking arrangement is thus provided which reduces twisting and distortion of the shoulders when the container is in use.

At the base of this embodiment of the container as shown in Fig. 7, there are a series of hinged members 62, each being integrally formed with an adjacent pair of opposed shoulders and interconnecting webs of container 50, which hinged members are foldable along hinge line 63. Referring now to Fig. 7 which illustrates the container in an open flat condition, the hinged members are raised relative to the corrugated side walls of the cavities in the manner of a plateau, as it were, but are below the level of the pointed edges 60a, 60b of the shoulders 53, 54. Between each adjacent pair of hinged members 62 and also between the gathered portions 65, 66 of the opposed shoulders and interconnecting webs of container 50 a comparatively wide and shallow channel-shaped depression 64 is formed. The shape of the hinged members 62 and channel-shaped depressions 64 is as shown in Figures 7 and 10. During the process of manufacture of the containers, the channel-shaped depressions 64 are slit in line with the hinges so that when the hinge is folded shut, the slit expands to provide a large drainage and air-pruning opening (not specifically shown in Figs. 7-10) for each cavity, at location 67. When the container is in the closed position as illustrated in Figure 10, each half of the hinged members 62 resembles a deltoid wing-shaped member. Root grooves 68, 69 are formed in the wall members 51, 52 for directing root growth.

In another embodiment illustrated in Figures 11 and 12, the container 70 is formed with shoulders 71, 72 and webs 73 which extend downwardly generally vertically, thereby providing a cell 74 of substantially constant cross-sectional area throughout its length. To prevent the contained peat moss or other growing medium from dropping out of the base aperture, substantially horizontal, mutually opposed, finger-like members 75, 76 extend inwardly from the lower edge portions of each opposed pair of webs 73, to form a

growing medium-retaining bar extending across the aperture to divide it into smaller air-pruning apertures 77. As illustrated, the members 75, 76 are preferably connected at their ends to provide a hinge. The shoulders are also interconnected at their bases by horizontal members 78—the members 75, 76, 78 combining to provide hinge means connecting the two wall members 79.

In another embodiment illustrated in Figure 13, the container 80 comprises separate wall members 81, 82 which may be inserted in a box 83 having a grid floor 86 as shown in Figure 14. When box 83 is filled, the container wall members 81, 82 hold themselves up. As illustrated, a slightly different shiplap joint is used.

When this last mentioned embodiment is in use, the roots grow down along the root grooves 84 to the aperture 85. Here they extend through the grid floor 86 and are air-pruned as described earlier. The members of the grid floor traverse the base aperture of each cell, helping to hold the peat moss (or other growing medium) within the cell.

Another specific feature of the folding ganged container of this invention is the design of the grooves in the side walls. The side walls of each container cell or unit are provided with alternating longitudinal ridges and grooves on the exterior as well as the interior, as can be seen from an inspection of the drawings. Each ridge on the outer container wall is disposed directly opposite a groove in the interior side wall of the same container; that is to say, the side walls of the container are corrugated. Each such groove (referring here to grooves 68, 69 in Fig. 7, and grooves 84 in Fig. 13) is so designed as to be in mating relationship with a corresponding ridge on the outer wall of a similar container placed in juxtaposition thereto, so that when another "book" or folded ganged container is placed next to it, the longitudinal ridges on the exterior walls of one such container mate with corresponding longitudinal grooves in the exterior walls of the container next to it, so that the containers are prevented from sliding laterally relative to each other.

Another specific feature of the folding ganged container of this invention is that the top portions of the wall members 51, 52 (Figs. 7, 10) extend vertically a short distance above the effective length of the container as flanges 51a, 52a (Figs. 7, 10). Referring here to Figs. 7 and 10 of the drawings, at predetermined spaced intervals along the length of wall members 51, 52 there project shoulder members 53, 54 which are normal to the plane of the wall members 51, 52. The wall members of the containers when in use are vertical so that the shoulder members are horizontally

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extending. Each pair of wall members and shoulder members combine to define a container cell for holding growing medium within which an individual seedling may be place. The top surface of shoulder members 53, 54 form ledges 53a, 54a (See Fig. 10) which, when the shoulders are joined together to provide a shiplap joint as previously described, form a ledge extending across the container. The vertically extending flanges 51a, 52a and ledges 53a, 54a are smooth and straight rather than grooved or corrugated, as with the side walls of the container, so that when the ledges fit together, the possibility of the growing medium becoming lodged between adjacent container cells and between abutting ganged containers is substantially prevented; and so that excess growing medium may be placed above the container cells and later compressed down into the container cells. The ledges also act as a standardizing level for screening off excess growing medium during the filling stage. These ledges have a further purpose, that of shielding the plant in its succulent stage from being heavily battered by strong water and fertilizer sprays, and of catching and directing such sprays to the grooves, thereby enticing the roots toward the last wet place between waterings, at the outside wall of the container.

A further specific feature of the folding ganged container of this invention is the shape of the seal between cavities or cells, which seal is similar to a shiplap seal, and provides in each cavity half (as observed when opened up) a high portion on the one side and a low portion the other side, which match universally like two right hands or two left hands in a handshake, each to the opposite cavity half. Closed, the cavity has seal lines which are thus off the centre line of the hinge by half the depth of the shiplap seal. The locking portions of this shiplap seal are like the thumbs of two right hands (or two left hands) and seal to the depth of the main shiplap seal. The crossover from one side to the other is made with a minimum of an opening, so as to provide the least possible chance for roots to work their way between cavities. This minimum opening is provided by making the crossover edges at 45° to the part line, so that the joint has only one small contact point. The joint is also kept as near to the top of the cavity as possible to again minimize root migration.

In use, a number of the containers of this invention, for example containers 50 as illustrated in Figs. 7—10, or containers 70, as illustrated in Fig. 11, or 80 as illustrated in Fig. 13, are stacked together in abutting relationship in an upstanding position in a tray or box. The containers are then filled

with a growing medium, such as treated peat, ground bark, vermiculite, expanded perlite, sterilized soil or sand. After watering and settling, the containers are seeded. A vacuum-head seeder may be used, which simply draws seeds from storage to small holes arranged in the pattern of the cavities. The seeder is then placed over the tray and the vacuum released, which allows seeds to drop into each cavity. Next, a mulch, generally of sand or limestone grit, is sprinkled to cover the seed. Trays are put in a suitably warm place and covered with a polyethylene film while the seeds germinate. Overseeding often is used to ensure 100% utilization, so thinning becomes part of a later operation.

Germination takes place normally in a moist atmosphere at 70°—75°F. A sheet of thin polyethylene is wrapped around a batch of seeded, watered trays. Heat build-up during this period must be watched to provide the best temperature. When seeds reach above 80°F their rate of germination may decrease. It has been found that early life of any plant is extremely sensitive to changes in environment, and it is desirable to keep plants in the greenhouse for at least 8 weeks after seeding, from the standpoint of the extra good start they get in life.

The containers of this invention are very useful during these first 8 weeks.

During growth of the seedling, the technique of "Air Pruning" is used to promote root growth. Normal growth of a root follows the path of least resistance, and guides such as the aforementioned grooves, tend to direct most of the roots which touch the side walls toward the bottom of the container. The biological urge which causes root growth is frustrated by the air which the emerging, growing root meets as it finds its way out of the bottom and withers off. This urge makes the roots within the container branch out further and more new roots then follow the grooves and ridges to the bottom where the process is repeated.

At any time during the seedling's growth, its root development may be inspected.

All that is necessary is to take the filled container containing the growing seedling(s) (which, since it can be opened up like a book, will be referred to here as a "book"), open the "book", and visually inspect the rootball (plug). If desired for this purpose the rootplug can be readily removed from the container and held in the hand, as illustrated in Fig. 15. The development of the seedling 88 (referring to that Figure) and in particular its roots 90 can be seen at a glance. After inspection is completed, the rootball plug 92 comprising the seedling root system within the compacted growing medium, is simply placed back in the

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individual container cell from which it was taken, and the "book" is closed.

At the same time as the root development of the seedling is being inspected, the inspector can tell by the colour of the growing medium whether there are dryness or over-watering problems. Root development in these early stages of development may be examined without damage to the plant.

When seedling has developed to the point where it is large enough to transplant, the seedling in its container is moved to a semi-controlled outdoors areas or to a small unheated greenhouse—the so-called "cold frame"—where the plant is acclimatized or "hardened" to outdoor conditions.

When moved out to the cold frames or open storage, the trays with enclosed containers are placed up off the ground. This enables "Air-pruning" to occur. "Air-pruning" is really a method of tricking the plant to put out branch roots. When the plant roots reach the open bottom of the container they dry off in the air. This temporary growth stoppage is biologically signalled to the seedling, and this triggers the development of new branch root growth. Since most roots are directed by the grooves in the container walls straight to the bottom, the process is speeded up by use of the containers of this invention. Normally, a nursery seedling, placed beside its fellows in a seed bed, develops very long roots that are few in number. The long roots cannot be transplanted so they are cut off, thereby "shocking" the transplant. In contrast thereto, seedlings grown in containers of this invention have all the roots intact when they are transplanted; so may be transplanted at any time, even when "flush" with new growth. All the roots of importance are on the outside, waiting to make contact with new soil, and they fan out evenly on all sides, making an ideal root system to prevent blowdowns at a later stage of growth.

The plant may then be taken directly to the transplanting area, and removed from the container by the same simple procedure as outlined previously herein in connection with the inspection of the seedling during its early growth.

Transplanting may be accomplished by ordinary standard methods, but the trays are compact and are often used to carry seedlings right to the site. A hoe, dibble, adze, mattock, spade or planting tube may be used. All methods have been tried with success in the field, and are chosen at the discretion of the planting supervisor.

The containers of the present invention and as hereinbefore described have a number of important advantages, summarized as follows:

1. The containers can be made in any desired size to accommodate numerous different varieties of seedling.

2. Minimum storage and shipping costs.

3. The containers are easy to load, fill, seed, thin and weed. 70

4. The container grooves—speed root development, minimize spiralling, promote healthy growth of contact roots, i.e., the roots which will first contact new soil when transplanted. 75

5. The containers allow inspection at any stage of growth. A "book" may be readily pulled out, opened, and one may "read" the root development of the seedling. 80

6. The containers allow removal of the seedling at any stage of growth, and removal is very easy. All that need be done is to open the container. Smooth, hard sides, a hinged bottom and linear grooves make removal easy. No time is lost in transplanting directly from the box in the field. 85

7. The containers give nearly maximum bench density, yet may be spaced out to give leaf room at later development stages, without losing their multiple handling advantage. 90

8. The containers are useful for a wide variety of horticultural techniques; rooting from cuttings, sprouting from root cuttings. "air-pruning" of heavily tap-rooted plant varieties, and for many kinds of plants, from trees to wild grasses, to shrubs, to vegetables. 95

9. The containers grow plants that are easy to transplant. No special equipment is required, yet they will easily adapt to the most sophisticated transplanting machines. 100

10. The containers are relatively inexpensive to manufacture. 105

WHAT WE CLAIM IS:—

1. A container for growing seedlings, said container being normally upstanding when in use and comprising: a pair of opposed first and second wall members, each formed of substantially non-porous sheet plastics material, each said wall member being formed by a series of spaced, inwardly-projecting, elongate shoulders integrally joined by webs, the shoulders of the first wall member being mutually opposed relative to the shoulders of the second wall member, said mutually-opposed shoulders being provided with inter-engaging means, whereby when the wall members are pressed together, a series of open-topped cells are formed, defined by the shoulders and their connecting webs and closed along the greatest part of their length; the lower end portions of each pair of opposed webs and integrally-joined shoulders combining to form the base of each cell, within which is formed an



17

individual container cell from which it was taken, and the "book" is closed.

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9. The containers grow plants that are easy to transplant. No special equipment is required, yet they will easily adapt to the most sophisticated transplanting machines. 100

10. The containers are relatively inexpensive to manufacture. 105

WHAT WE CLAIM IS:—

1. A container for growing seedlings, said container being normally upstanding when in use and comprising: a pair of opposed first and second wall members, each formed of substantially non-porous sheet plastics material, each said wall member being formed by a series of spaced, inwardly-projecting, elongate shoulders integrally joined by webs, the shoulders of the first wall member being mutually opposed relative to the shoulders of the second wall member, said mutually-opposed shoulders being provided with inter-engaging means, whereby when the wall members are pressed together, a series of open-topped cells are formed, defined by the shoulders and their connecting webs and closed along the greatest part of their length; the lower end portions of each pair of opposed webs and integrally-joined shoulders combining to form the base of each cell, within which is formed an



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aperture, said webs constituting the predominant portion of the side walls of the container, and each pair of opposed webs forming the side walls of an individual cell of said series of cells; each said web having root directing grooves longitudinally of said cell, the grooves in the interior side walls of each said cell extending downwardly toward the base aperture for directing root growth toward said aperture.

2. A container as defined in Claim 1 wherein each said web is corrugated longitudinally of said cell, the grooves of the corrugations in the interior side walls of each said cell constituting said root directing process.

3. A container as defined in Claim 1 or Claim 2, wherein said plastics material is flexible.

4. A container as defined in any one of the preceding claims wherein said first and second wall members are thin-walled.

5. A container as defined in any one of the preceding claims wherein for each said cell, said aperture is smaller than the aperture at the top of the cell.

6. A container as defined in any one of the preceding claims wherein the lower end portions of each pair of opposed webs are curved inwardly and the corresponding lower end portions of each pair of integrally-joined shoulders are inwardly flared, the arrangement being such that the base of each cell has an internal cross-section less than that at the top of each cell.

7. A container as defined in any one of claims 1 to 4 wherein a pair of substantially horizontal, mutually-opposed, finger-like members extend in from the lower end portions of each pair of opposed webs to form a growing medium-retaining bar extending across the base aperture.

8. A container according to claim 7 wherein said shoulders and webs extend downwardly generally vertically, whereby cells of substantially constant cross-sectional area along most of their length are provided.

9. A container according to any one of the preceding claims wherein the opposed shoulders are so constructed as to provide a shiplap joint along the greatest part of their lengths when pressed together, said shiplap joint maintaining separation between adjacent cells and restraining intermingling of root systems in said cells.

10. A container according to claim 9 wherein each shoulder of said first wall member is rebated to define a first indentation along one side edge thereof, and each shoulder of said second wall member is rebated to define a second indentation along one side edge thereof, whereby the non-rebated portion of the first shoulder seats in the second indentation and the non-rebated portion of the second shoulder seats in the first indentation when the wall members are in the closed position to provide a shiplap joint.

11. A container according to claim 10 wherein the first and second indentations terminate short of the upper ends of the shoulders, the first shoulder is rebated along its remaining side edge opposite to said one side edge thereof, to define a short indentation at its upper end, and the second shoulder is rebated along its remaining side edge opposite to said one side edge thereof, to define a short indentation at its upper end, whereby the non-rebated upper portion of each shoulder seats in the short indentation of the opposed shoulder when the container is closed to provide an interlocking arrangement which reduces twisting and distortion of the shoulders when the container is in use.

12. A container as defined in any one of the preceding claims wherein the upper portions of each wall member of said container extend vertically a short distance above the upper edges of the shoulder members and form a pair of mutually-opposed flanges, said upper edges of the shoulder members forming a ledge extending across the container when the shoulders are inter-engaged, said ledge and said flanges being smooth and straight.

13. A container according to any one of the preceding and including hinging means connecting the wall members at their lower ends.

14. A container as defined in claim 13 wherein said hinging means takes the form of a series of hinge members, each of which is integrally formed with an adjacent pair of opposed shoulders and inter-connecting webs of said container, there being between each pair of adjacent hinge members a relatively wide, shallow channel-shaped depression provided with a slit along the line of folding of said hinge, such that when the container is closed, in which condition the hinge member is folded, the slit expands to provide a drainage aperture at the base of the cell, said aperture being arranged to provide a root pruning function when an air gap is provided beneath the aperture.

15. A container as defined in claim 2 wherein the ridges on the exterior of the longitudinally-corrugated side walls are so configured as to mate with corresponding grooves on the exterior of the corrugated side walls of a second counterpart seedling-growing container when the latter is in abutting relationship to the first-mentioned container, said configuration being thereby adapted to prevent relative lateral movement of said containers.

16. A container as defined in any one of



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the preceding claims wherein each of said root grooves is of a size and shape such as to direct root growth downwardly by the shortest route to said base aperture

5 17. In combination:

(a) a plurality of upstanding containers for growing seedlings, each said container comprising a pair of opposed first and second wall members, each formed of substantially non-porous sheet plastics material, each said wall member being formed by a series of spaced, inwardly-projecting, elongate shoulders integrally joined by webs, the shoulders of the first wall member being mutually opposed relative to the shoulders of the second wall member, said mutually-opposed shoulders being provided with inter-engaging means, whereby when the wall members are pressed together, a series of open-topped cells are formed, defined by the shoulders and their connecting webs and closed along the greatest part of their length; the lower end portions of each pair of opposed webs and integrally-joined shoulders combining to form the base of each cell, within which is formed an aperture, said webs constituting the predominant portion of the side walls of the container, and each pair of opposed webs forming the side walls of an individual cell of said series of cells; each said web having root directing grooves longitudinally of said cell, the grooves in the interior side walls of each said cell extending downwardly toward the base aperture for directing root growth toward said aperture; and

(b) a holder for said containers, said holder having side and end walls and a flat, foraminous bottom for retaining growing medium in the cells, said containers being disposed in abutting relationship with respect to each other and to the walls of the holder, said containers being so arranged as to fill said holder.

18. The combination according to Claim 17, wherein each said web is corrugated longitudinally of said cell, the grooves of the corrugations in the interior side walls of each said cell constituting said root directing grooves.

19. The combination according to Claim 17 or Claim 18 wherein said plastics material is flexible.

20. The combination according to any one of claims 17 to 19 wherein said first and second wall members are thin-walled.

21. The combination of any one of claims 17 to 20 wherein for each cell, said aperture is smaller than the aperture at the top of the cell.

22. The combination according to any one of Claims 17 to 21 wherein said holder is a box.

23. The combination according to any

one of Claims 17 to 21 wherein said holder is a tray.

24. The combination according to Claim 22 wherein the box has an open grid bottom, the members of the grid bottom of said box traversing the base aperture of each cell of said containers.

25. The combination according to any one of Claims 17 to 24 wherein in each cell of said containers a pair of substantially horizontal, mutually-opposed finger-like members extend in from the lower end portions of each pair of opposed webs to form a growing medium-retaining bar extending across the aperture.

26. The combination according to any one of Claims 17 to 25 wherein the opposed shoulders are so constructed as to provide a shiplap joint along the greatest part of their lengths when pressed together, said shiplap joint maintaining separation between adjacent cells and restraining intermingling of root systems in said cells.

27. The combination as set forth in any one of claims 17 to 26 wherein the upper portions of each wall member of each of said containers extend vertically a short distance above the upper edges of the shoulder members and form a pair of mutually-opposed flanges, said upper edges of the shoulder members forming a ledge extending across the container when the shoulders are inter-engaged, said ledge and said flanges being smooth and straight.

28. The combination according to any one of claims 17 to 27 wherein each said container includes hinging means connecting the wall members at their lower ends.

29. The combination as set forth in claim 28 wherein in each of said containers said hinging means takes the form of a series of hinge members, each of which is integrally formed with an adjacent pair of opposed shoulders and inter-connecting webs of said container, there being between each pair of adjacent hinge members a relatively wide, shallow channel-shaped depression provided with a slit along the line of folding of said hinge, such that when the container is closed, in which condition the hinge member is folded, the slit expands to provide a drainage and root-pruning aperture at the base of the cell.

30. A combination as set forth in Claim 18 wherein the ridges on the exterior of the longitudinally-corrugated side walls of each container are so configured as to mate with corresponding grooves on the exterior of the side walls of another of said containers abutting therewith, thereby to prevent lateral movement of the containers relative to others of said containers juxtaposed thereto.

31. A combination according to claim 25,



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holder 10
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wherein the shoulders and webs of each of
said containers extend downwardly
generally vertically, whereby cells of
substantially constant cross-section area
are provided for each of said containers.
32. A container according to claim 8
wherein said fingerlike members are joined
at their ends, and the shoulders are inter-
connected at their bases by horizontal
members, said joined finger-like members
and said horizontal members constituting a
hinging means connecting the wall
members of the container at their lower
ends.
33. The combination according to claim
17, wherein in each container said first and
second wall members are separate (i.e., not
joined together at any point), said wall
members being held together to form said
container in upstanding position by the
combination of (1) the abutting relationship
of said wall members with similar wall
members of adjacent containers and (2) the
abutting relationship of those containers (of
said arrangement of containers) adjacent
the walls of said holder, with said holder
walls.
34. A container according to claim 13
wherein said hinging means comprises a
rectangular, horizontally-extending
member integrally formed with and
extending outwardly from said wall
members at their lower ends, said member
constituting a platform base for said
container, whereby said container is
freestanding.
35. A container according to claim 34
wherein said rectangular, horizontally-
extending member is provided with a series
of downwardly-extending lugs, whereby the

container is elevated slightly above a
surface on which said container rests.
36. A container according to claim 34, or
claim 35 wherein, in alternate shoulders of
said series of shoulders of the first wall 45
member, there are formed tapered sockets,
and the corresponding alternate opposing
shoulders of the second wall member are
provided with lugs which engage said
sockets in mating relationship, thereby 50
holding the container closed when the wall
members are pressed together.
37. A container for growing seedlings,
said container being substantially as
hereinbefore described with reference to, 55
and as illustrated in, Figures 1 to 6 or
Figures 7 to 10 or any one of Figures 11 to
13 of the accompanying drawings.
38. A combination of a plurality of
containers for growing seedlings and a
holder for said containers, said
combination being substantially as
hereinbefore described with reference to, 60
and as illustrated in, Figure 14 of the
accompanying drawings.
39. A seedling which has been grown in a
container according to any one of claims 1
to 16 or claim 32 or any one of claims 34 to 65
37 or in a container of a combination
according to any one of claims 17 to 31 or 70
claim 33 or claim 38.

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ERRATUM

SPECIFICATION No. 1,535,974

Page 8, line 107, *delete* whole line *insert*
WHAT I CLAIM IS:—

THE PATENT OFFICE
5th March, 1979