

PATENT SPECIFICATION

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(54) CONTAINERS FOR GROWING PLANTS

(71) We, ILLINOIS TOOL WORKS INC.,
 a corporation organized under the laws of
 the State of Delaware, United States of
 America, of 8501 West Higgins Road,
 Chicago, Illinois 60631, United States of
 America, do hereby declare the invention,
 for which we pray that a patent may be
 granted to us, and the method by which it
 is to be performed, to be particularly des-
 cribed in and by the following statement:—

Containers of various types in which
 plants may be grown for later transplant-
 ing are known in the prior art. Many of
 these containers have provided for satisfac-
 tory growth of the plant from seed to a
 seedling stage in a nursery or greenhouse,
 but have proved inadequate when the seed-
 ling and the container, or some part of the
 container with the seedling growing therein,
 have been transplanted in the open ground.
 Various reasons appear for the inadequacy
 of prior art containers which are intended
 to be transplanted or planted in the open
 ground. In some prior art arrangements,
 plants with tender seedling roots are sub-
 stantially incapable of breaking through or
 growing out of the container. Other plants
 with stronger seedling roots may grow out
 of the container, but often with substantial
 setback in growth compared to the normal
 growing cycle of such a plant growing in
 open ground without being confined by such
 a container. In other known prior art con-
 tainers, the container configuration is such
 that the roots of many plants will be
 caused to spiral in growing in such con-
 tainers or in attempting to grow out of such
 containers into the open ground, and the
 spiraling of the roots may result in a serious
 setback in the growth rate of the plant. In
 still other prior art containers intended to
 be planted in the open ground with a seed-
 ling or cutting growing therein, the container
 presents wall surfaces which, when engaged
 by a seedling root, will direct the seedling
 root in its further growth in an upward di-
 rection rather than in a normal radially out-
 ward and downward direction. Such up-

ward growth of the roots of many plants will
 seriously retard the plant in its normal
 growth and in some instances will cause the
 plant to mature as a miniature of a normal
 plant. In still other prior art containers,
 which constitute a frame which may be in-
 serted in open ground, drainage openings
 are provided having a continuous periphery
 and such openings will admit roots there-
 through with detrimental effects on the over-
 all growth of the plant. In still other prior
 art containers which constitute a frame, the
 base of the frame is not closed nor provided
 with a ground penetrating configuration, so
 that, when the frame is pushed or inserted
 in the ground, the ground can react against
 the plant root mass through the base of the
 frame to prevent or interfere with the in-
 sertion of the plant and frame together into
 the ground.

A container according to the present in-
 vention comprises the combination of a
 frame member and a removable sleeve, said
 frame member comprising a base section
 having a closed upper surface devoid of any
 openings capable of passing water there-
 through, and a plurality of ribs secured at
 their lower ends in a spaced-apart relation-
 ship about the periphery of said base section
 such that the longitudinal axes of the ribs up-
 stand therefrom, said sleeve being formed
 in a substantially tubular shape from flex-
 ible sheet material, said sleeve being
 mounted about and supported by said ribs,
 the lower edge of said sleeve being spaced
 from the periphery of said base section to
 provide drainage openings therebetween.

As opposed to the known containers of
 the prior art, a container according to the
 present invention is shaped to avoid both
 root spiraling and upward root growth as a
 seedling or cutting grows in the container in
 a nursery or greenhouse, is further shaped
 to avoid root strangulation, is further shaped
 for easy ground insertion, and will further
 present substantially no interference to
 mature growth as the roots of the plant
 grow out of the frame member after the
 container, after removal of the sleeve, has

been planted in the open ground with the plant growing therein.

5 In its initial manufactured condition, the ribs of the frame member may diverge in an upward direction from the base member so that a plurality of such frame members, substantially identically formed, can be nested for compact storage and/or shipment separately from the sleeves.

10 The base section of the frame member is a closed surface devoid of any openings capable of passing water therethrough. That construction avoids a situation where a plant root might attempt to grow into or
15 through an opening in the base section and be strangled in its confinement by the peripheral walls of the opening. Preferably the upper surface of the base section is shaped as an upwardly directed convex surface, so
20 that any plant roots which grow downwardly thereagainst, either in the initial growth of the plant in a greenhouse or in its further growth in the open ground, will be directed by the convex surface in directions radially
25 outwardly and downwardly of the base section.

The sleeve member is substantially tubular, and formed of a flexible sheet material which can be discarded when the plant is ready
30 for transplanting. In the arrangement of the container for the growth of a seedling from seed in the container or the growth of a cutting inserted in the container, the tubular sleeve is disposed about the ribs and
35 is supported by the ribs. The lower edge of the sleeve is spaced upwardly from the periphery of the base section to define drainage openings between that lower edge of the sleeve and the periphery of the base section.
40 The container of the invention may be used to grow many different types of plants which are preferably first grown from seed to a seedling stage in a greenhouse and thereafter planted in the open ground, such for
45 example, as conifers which are commercially grown for use in reforestation programmes. The container may also be conveniently used to root cuttings that have been taken from other mature plants.

50 Under proper growing conditions of moisture, nutrients and light, the seed will germinate or the cutting will root, sending developing roots downward into the growing medium and top growth upwardly out of
55 the container. After a suitable time period, which may be about six months for some types of conifers grown from seed, the container will have a substantial mass of roots therein. Theroots in growing downward
60 and radially outwardly will, of course, contact the ribs and sleeve and will be substantially prevented by the ribs from spiraling. As the roots reach the base section they
65 will be directed downwardly and radially outwardly toward the drainage openings.

Air pruning of the roots may occur at the drainage openings.

The next step in the use of the container of the invention is to carry the container to a desired ground site or other area where
70 transplanting or further growth of the plant is desired. The sleeve member is then stripped from the container to expose the root mass and, using the skeletal frame member as a support for the root mass and growing
75 medium, the frame member and plant together are planted in the open ground or other area. A number of different methods may be used for planting the frame member and plant in the ground or other area. For
80 example, an appropriate opening may be made in the ground with a dibble to receive the frame member and plant. In other contemplated embodiments, the frame member may be manufactured with a ground penetrating
85 nose on the underside of the base section of the frame member, and the frame member may then be pushed into the ground with an appropriate planting tool to be described later, or by a machine.

90 When the frame member and plant are transplanted, after removal of the sleeve member, the roots of the plant may grow radially outwardly as well as downwardly of the frame member into the adjacent soil. The
95 frame member will have substantially no detrimental effect on the growth of most plants growing out of the frame member. Because the ribs are of comparatively small width, the major circumferential portion of
100 the frame member is open to permit the roots to freely grow radially outwardly of the frame member. Tap roots of the plant growing downwardly may be directed by a convex shape of the upper surface of the
105 base section outwardly and downwardly of the base section to provide for a minimum disturbance in the normal pattern of root growth of the tap roots of various plants. Even with plants of a type having a substantially
110 single tap root, that tap root can grow downwardly out of the frame member with a minimum horizontal offset in its downward path of growth. Thus, both before and after transplanting, the container
115 provides for the substantial healthy growth of plants.

One possible planting method for a plurality of plants, using a plurality of containers each with a ground penetrating nose, comprises the steps of placing a growing medium
120 and a plant seed or cutting in each of said plurality of containers and growing said plants therein, thereafter transporting said plurality of containers to a transplanting site,
125 removing the sleeve from one of said containers and inserting said frame member in a planting tool having a tubular section at one end capable of accepting said frame member with the ribs longitudinally within the tubular
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section and with the free edge of said tubular section abutting the annular shoulder on said base section, pushing said tubular section into the ground until said ribs are within the ground, and withdrawing said tubular section to leave said frame member with the plant growing therein in the ground, tamping the ground about said planted frame member, and thereafter repeating the steps for the remaining containers, from the step of removing the sleeve from one of said containers.

For some plants with substantial top growth, a longitudinally extending slot may be provided in the wall of the tubular section so that the ribs with the root mass therein may be received within the tubular section of planting tool with part of the top growth of the plant extending exteriorly of the planting tool through the slot. The end of the tool receiving the container frame member may be further provided with a transversely extending bar and planting stop so that a person may align the tool with the base section of the container frame member against the ground and with one foot on the bar may project the frame member and the end of the tool into the ground until the stop engages the top of the ground.

The tool is then drawn upwardly to pull the lower end out of the ground leaving the frame member and plant growing therein in the ground at a desired depth.

Appropriate machines may also be used for high speed planting of the frame members with plants growing therein where large numbers of plants must be transplanted over many acres of land.

The accompanying drawings show three examples of containers which embody the invention, and illustrate one planting method. In these drawings:—

Figure 1 is an isometric view of the frame member of one container;

Figure 2 is a top plan view of the frame member of Figure 1;

Figure 3 is a side elevational view of the frame member of Figure 1 in cross section;

Figure 4 is a view of a plurality of frame members, such as shown in Figure 3, showing the manner in which the frame members may be nested for shipment or storage without the sleeves;

Figure 5 is a side elevational view of a frame member, as shown in Figures 1 to 4, assembled with a sleeve to produce a container, and further showing a conifer seedling growing in the container;

Figure 6 is a side elevational view of a frame member of another container;

Figure 7 is a vertical cross-sectional view of the frame member shown in Figure 6;

Figure 8 is a side elevational view of a complete container including the frame member of Figure 6 and a sleeve;

Figure 9 is a bottom end view of the frame member shown in Figure 6;

Figure 10 is a cross-sectional view of the frame member shown in Figure 6 taken substantially along the line 10—10 of Figure 6;

Figure 11 is a substantially isometric view of the frame member of a third container;

Figure 12 is a slightly enlarged isometric view of one of the two parts that make up the frame member of Figure 11;

Figure 13 is a side elevational view of a completed container including the frame member of Figure 11 and a sleeve;

Figure 14 is an enlarged cross-sectional view of the nose portion of the frame member shown in Figure 11, taken substantially along the line 14—14 of Figure 11;

Figure 15 is a view similar to Figure 14, but with the parts of the nose portion slightly separated;

Figure 16 is an enlarged cross-sectional view of the frame member shown in Figure 11, taken substantially along the line 16—16 of Figure 11;

Figure 17 is an enlarged fragmentary view of the frame member shown in Figure 11, taken substantially along the line 17—17 of Figure 16;

Figure 18 is an enlarged cross-sectional view of the container shown in Figure 13, taken substantially along the line 18—18 of Figure 13;

Figure 19 is a view showing a person inserting the frame member of one of the embodiments of the invention, with the sleeve removed, into one form of planting tool that may be used with the present invention;

Figure 20 shows a person having turned the tool of Figure 19 with the inserted frame member and plant end-for-end, preparatory to planting the plant with the frame member;

Figure 21 shows a person gripping the planting tool and having pressed the lower end of the tool into the ground with one foot; and

Figure 22 shows a person having withdrawn the lower end of the tool from the ground, having again reversed the tool end-for-end, and tamping the ground about the planted plant and frame member.

In the three embodiments of the invention shown, the container comprises a frame member and a sleeve which are respectively: 10 and 11 in Figure 5; 19 and 24 in Figure 8; and 29 and 38 in Figure 13.

The frame member may be formed of any suitable material or composite materials, and a preferred material is a thermoplastic material, such as polystyrene. The frame member may be suitably formed by known injection moulding processes, and the plastics material may be blended with other inert, or fertilizing fibres, or granules of approx-

prate substances, if desired. It is further contemplated that the frame member may include, or be treated with, substances which will repel or destroy animals, insects or other organisms that might be injurious to the plant during its growth period in the container and in the frame member in the open ground.

The frame member 10 of Figure 1 to 5 comprises a base section 12 and a plurality of ribs 13. The base section 12 preferably has a substantially circular periphery from which the ribs 13 extend upwards, and an upper surface which is upwardly convex. In the embodiment of Figures 1 to 5, the upper surface of the base section 12 is formed to have a four-sided pyramidal shape as shown in the drawings. It is contemplated that the upper surface may also be pyramidal-shaped with more than four sides or may be cone-shaped. The upper surface of the base section 12 is further devoid of any openings which might pass water therethrough, to avoid a condition where roots of the plant growing in the container might attempt to grow through such openings and be strangled by the peripheral walls of such openings.

The ribs 13 of the frame member 10 are four in number. In the initial manufactured condition of the frame member 10, the ribs 13 diverge upwardly of the base section 12 as shown in Figures 1 to 4. Further, each rib 13 is preferably formed of two longitudinally extending walls disposed at an angle to each other. The ribs 13 are connected to the base section 12 so that the line of convergence of the walls of each of the ribs 13 lies on one of the junction lines of two adjacent sides of the pyramidal upper surface of the base section 12.

As may be seen in Figure 4, a plurality of frame members 10, as shown and described above, may be nested to produce a compact arrangement for the storage and/or shipment of such frame members 10. If desired, to strengthen the ribs 13 and to aid in holding the sleeve 11 on the ribs 13, the upper end of each rib 13 may be provided with a wall 14 connected transversely of the walls of the ribs 13.

In the nestable form of the frame member 10, the material and construction of the frame member 10 should be such that the ribs 13 can be brought into substantial parallel alignment when the tubular sleeve 11 is mounted thereabout. The sleeve 11 is preferably formed of a film-like material. One available suitable material which may be used is bi-axially oriented polystyrene of a thickness of about 0.003 inch. Because such a plastics film material will have some resiliency, the ribs 13 may be slightly bowed outwardly when the sleeve 11 is circumferentially mounted about the ribs 13 as shown

in Figure 5. Further, when the sleeve is formed of an oriented plastics film, some heat shrinking of the sleeve may be done to produce a firm engagement and support of the sleeve 11 by the ribs 13.

If necessary to prevent light from retarding root growth, the sleeve 11 may further be formed of an opaque material, or it may be rendered opaque by some appropriate coating. Further, if desired or necessary, to provide firm contact between the ribs 13 and the sleeve 11, the sleeve 11 may be welded or otherwise adhesively secured to the ribs 13. However, any bond between the sleeve 11 and the ribs 13 should be such that when the plant, which has been grown in the container to the transplanting stage, is to be transplanted, that bond has disappeared or can easily be broken with the intended removal of the sleeve 11.

The sleeve 11 is mounted on the frame member 10 so that the lower edge of the sleeve 11 terminates a sufficient distance upwardly from the peripheral edge of the base section 12 to provide adequate drain openings 15 at the lower outer periphery of the container. Then a growing medium may be placed in the container and a seedling or cutting, such as the seedling 16 shown in Figure 5, may be grown therein. As a seedling or cutting develops roots in the growing medium, the roots of the growing plant will grow downwardly and outwardly throughout the growing medium. Any roots engaging the inner surface of the sleeve 11 and possibly beginning to spiral will, upon engaging a rib 13, be directed downwardly to avoid root spiraling. As the roots reach the upper surface of the base section 12, the pyramidal surface will direct the roots downwardly and radially outwardly toward the drainage openings 15. As the roots reach the drainage openings 15 they may be appropriately air pruned. It may be seen from the drawing and the foregoing description that no wall surfaces exist in the container which are likely to cause the root of a plant growing therein to be directed in an upward direction.

The sleeve 11 is further provided with means for opening the sleeve to remove it from the frame member 10. One suitable opening means is shown in Figure 5 and comprises a weakening strip 17 which extends longitudinally of the sleeve 11 and terminates at its lower end in an appropriate finger gripping tab 18. If the tubular sleeve is formed into the tube shape by rolling up a sheet material, the abutting or lapped edges of the sleeve may be sealed with a pressure-sensitive waterproof tape leaving a projecting end that can be pulled to remove the tape and open and remove the sleeve.

When the plant 16 has grown to a size such that it is ready for transplanting, the

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5 sleeve 11 is removed, while the frame member 10 is retained about the root mass of the plant to avoid a falling apart of the root mass or a disorganization of its normal root pattern. Using a dibble, a hole may be made in the transplanting site and the frame member 10 with the plant growing therein may be pushed into the hole to plant the plant 16 with a minimum of disturbance of the root mass.
10 In the embodiments of Figures 6 to 18 the base section of the frame member is provided with an appropriate ground penetrating outer configuration which may be bullet-shaped for easy insertion of the frame member into the ground in the transplanting operation. Although the base sections of the embodiments of Figures 6 to 18 are shown as hollow closed members, the hollow space within those base sections can, in the alternative, be solid or filled with some inert substance if additional rigidity is desired.
15 Further, in the embodiments of Figures 6 to 18 the upper ends of the base sections are also provided with a cone or pyramid-shaped upper surface. Additionally, in each of the frame members of the embodiments of Figures 6 to 18, the lower end portions of the ribs are so formed in cooperation with the upper surfaces of the base section that no effective root entrapment or redirection of the roots of the plants growing in the container will occur in any direction other than radially outwardly and downwardly of the container.
20 Further, in the embodiments of Figures 6 to 18, the frame members are made as two-piece members which are secured together to form the completed frame member. Of course, it should be understood that those embodiments can be made as one-piece frame members where a moulding or forming process permits the frame members to be formed as one-piece members.
25 The frame member 19 of Figures 6 to 10 comprises a base section 20 and ribs 21a constituting a shank section 21. The base section 20 is a member having a closed or sealed chamber defined by a side wall 20a and a top wall 22 thereof. The side wall 20a is formed as a circumferentially closed wall which is shaped somewhat as the shape of an armour-piercing bullet. The upper or top wall 22 of the base section 20 is formed to have a closed upwardly directed cone-shaped surface 22a, a circular shoulder 22b circumferentially about the cone-shaped surface 22a and smoothly blending therewith, and a depending annular projection 22c which depends substantially from the junction of the cone-shaped surface 22a and the circular shoulder 22b. The outer diameter of the circular shoulder 22b is substantially equal to the outer upper diameter of the bullet-shaped side wall 20a of the
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base section 20. The outer diameter of the depending annular projection 22c is substantially equal to the upper inner diameter of the bullet-shaped wall 20a of the base section 20. Thus, the bullet-shaped wall 20a and the top wall 22 of the base section 20 will fit together substantially as shown in Figure 7. The side wall 20a and the top wall 22 may be frictionally retained together to form the completed base section 20 of the frame member 19, or may be adhesively or otherwise integrally interconnected.
70 In the embodiment of Figures 6 to 10, the side wall 20a may be separately moulded from the top wall 22, which in turn may be moulded as a one-piece member with the four ribs 21a of the shank section 21. In moulding or otherwise forming the various described parts of the frame member 19, the separate parts may be made of the same material, such as a plastics material, or where appropriate, different materials may be used for the described two moulded parts.
75 The four ribs 21a of the shank section 21 are formed to upstand from the upper surface of the top wall 22 of the base section 20. The ribs 21a are arcuate in transverse cross section and are arranged in a horizontally spaced-apart relationship on the circle which may be defined as the junction between the cone-shaped surface 22a and the circular shoulder 22b of the top wall 22 of the base section 20. Each of the wall sections 21a further includes a vertical radially inwardly extending bead 23. The beads 23 are substantially uniform in cross-sectional shape in the central and upper portions of the ribs 21a. The lower portions of the beads 23 are flared both radially inwardly and circumferentially of the ribs 21a in a downward direction to merge in smooth curves into the cone-shaped surfaces 22a and into the vertical sides of the ribs 21a as may be seen in Figures 7 and 10. From the foregoing, it may be seen that the ribs 21a, including the beads 23, in combination with the surfaces 22a and 22b will direct any roots, which are growing downwardly in the frame member 19, in a radially outward direction at the lower end of the shank section 21. Thus, no surface is defined that may trap a generally downwardly growing root, or cause it to reverse its direction of growth to an upwardly growing direction. The central and upper uniformly shaped portions of the beads 23 tend to prevent root spiraling as the roots of a seedling growing in the container grow radially outwardly sufficiently to meet the ribs 21a.
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130 As with the previously described embodiment, a sleeve 24 is provided on the frame member 19 to form the complete planting container. The sleeve 24 firmly encircles the shank section 21 of the frame member 19

and is formed of a thin sheet material, such as a plastics material. The lower end of the sleeve 24 terminates a short distance above the upper surface of the circular shoulder 22b of the base section 20 as may be seen in Figure 8, to provide four drain or weep openings, such as the opening 25 shown in Figure 8. If the sleeve 24 is formed of a heat shrinkable film material, then in the application of the heat shrinkable film to the shank section 21, the upper end of the sleeve 24 may be tucked into the upper end of the frame member, as shown by the dotted line 26 in Figure 8. That inward folding of the upper end of the sleeve 24, in shrinking the sleeve 24 on the frame member 19, will serve to firmly hold the upper ends of the ribs 21a in circular alignment, particularly if those ribs 21a are relatively thin and fragile.

The construction of Figure 8 includes a further alternative, and that is the arrangement of the upper ends of the ribs 21a in a slightly radially inwardly directed direction. That radially inward curving of the upper ends of the ribs 21a may conveniently be produced during the process of heat shrinking of the sleeve 24 on the frame member, when the ribs 21a are formed of a thermoplastic material. That construction as shown in Figure 8 produces a restricted open upper end to the container and conveniently serves to prevent accidental dislodgement of a plant growing in the container if, in handling, the container is inverted and jarred.

The sleeve 24 may conveniently be made with a pull tab 27 and a weakened line or lines 28, so that a person may grasp the pull tab 27 and tear, preferably upwardly, to open and remove the sleeve 24 from the frame member 19 immediately prior to the planting of the frame member 19 and the plant growing therein.

In the embodiment of Figures 11 to 18, the frame member 29 is formed of two parts which when assembled together as shown in Figure 11 form the complete frame member 29. It is contemplated that each part of the frame member 29 may be moulded as a single part 30, such as shown in Figure 12, and such parts may then be put together, as shown in Figure 11.

Each part 30 comprises an integral assembly of one-half 31 of a base section, two upstanding ribs 32, and one-half 33 of an upper ring.

The base half 31 comprises a side wall which is semi-circular in transverse cross section and has a cone or bullet-shaped outer side wall 31e and further includes one full side 31a and two half sides 31b and 31c of a pyramid. The full side 31a and the side halves 31b and 31c of the pyramid smoothly merge at their lower edges into the upper

inner wall portion of the bullet-shaped side wall 31e. The upper edge of the side wall 31e has sufficient thickness to define a semi-circular shoulder 31d for abutting engagement with the end of a planting tube tool, as will be described hereinafter.

Figures 12, 14 and 15 show one way in which the frame member parts 30 may be joined together at the base halves 31. In the embodiment of Figures 11 to 18, only the base halves 31 are firmly secured together, the ring halves 33 need not be secured together, but may merely cooperate in an abutting relationship. However, if growth of the plant in the frame after transplanting would not be affected by the ring halves 33 being secured together, they may be so secured. The joining system of the base halves 31, as shown, includes the moulding of four bosses 34, 35, 36 and 37 on the inner surface of the base half 31. Bosses 34 and 35 are at the same vertical position on opposite inner wall portions of the base half 31, and bosses 36 and 37 are at the same vertical position on opposite inner walls of the base half 31. Boss 34 is provided with a pin projection 34a and boss 35 is provided with a recess 35a, such that when two base halves 31 are positioned as shown in Figure 15 the projections 34a will enter the recesses 35a as shown in Figure 14 when the two base halves 31 are moved together. In a similar manner the boss 36 is provided with a recess 36a and the boss 37 is provided with a projection 37a to further interengage in the mating cooperation of two base halves 31. The two base halves 31 may be further physically interconnected in the completed frame member 29 in a number of different ways if necessary. An appropriate adhesive may be used between the mating edges, or some process such as ultrasonic welding may be used.

The frame member parts 30 must be so formed that when the base halves 31 are joined together, the mating lines between two sets of half sides 31b and 31c on two sides of the defined pyramid will not admit the roots of a plant growing in the container between the two base halves 31.

The ribs 32 are substantially triangular in transverse cross section. The lower ends of the two ribs 32 are moulded on the base half 31 to upstand therefrom in a horizontally spaced-apart relationship. The ribs 32 are further arranged so that one side thereof lies substantially tangentially on the semi-circle traced by the radially inner edge of the semi-circular shoulder 31d, and so that the other two sides of the triangular cross section ribs 32 extend from the one side and meet in an apex on one of the edges of the pyramid side wall 31a. Thus, as may be seen in Figure 18, the roots of a plant growing in the container will, in grow-

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ing downward to the pyramid, be deflected downwardly and radially outwardly, and any root that engages a rib 32 will be deflected on one side or the other of the apex of the rib to continue growing downwardly and radially outwardly. The construction as defined is free of any surface configuration which might tend to direct any root in an upward direction.

5 The radially outward sides of the ribs 32 merge at their upper ends into the flat semi-circular outer surface 33a of the semi-circular ring half 33. The ribs 32 are thicker in a radial direction than the ring half 33, and the radially inward portions of the upper ends of the ribs 32 taper in two directions to end in a point at the upper edge of the ring half 33 as may be seen in Figure 17. At the upper edge of the flat surface 33a, the ring half 33 is provided with a chamfered surface 33b which extends upwardly and radially inwardly to the inner wall of the ring half 33. One end of the ring half 33 is formed with a V-shaped groove and the other end is formed with a complementary V-shaped projection so that when two ring halves 33 are brought together as shown in Figure 16, the two ring halves will be guided into meeting together in a circle, as shown in Figure 16.

10 The sleeve 38 for the embodiment of Figures 11 to 18 is mounted about the shank section of the frame member 29 substantially as shown in Figure 13. The lower end of the sleeve 38 terminates a short distance upwardly from the circular shoulder 31d to provide drain holes 39 between the four ribs 32 of a complete frame member 29 circumferentially thereabout. The holes 39 function to drain excess water from the container and to permit air pruning of any roots that begin to grow out of those openings. Although the sleeve 38 may be made of a thin elastic material and merely stretched and applied about the shank section of the frame member 29, the embodiment of the sleeve 38 shown in Figures 13 and 18 is a heat shrinkable film sleeve. In applying such a heat shrinkable film sleeve, a mandrel (not shown) may be inserted into the upper end of the frame member 29 to extend into and through the shank section thereof prior to shrinking the heat shrinkable film sleeve about the frame member 29. Preferably, the mandrel should have an outer diameter substantially equal to the inner diameter of the ring halves 33 and at least four longitudinally extending V-shaped slots to receive the radially inwardly extending apex portions of the ribs 32. As a normal procedure, the film sleeve before shrinking would be substantially longer than the shank section of the frame member 29 to allow for shrinkage of the sleeve in the longitudinal direction in addition to the de-

sired radial shrinkage. Conventionally, heat for shrinking the film sleeve is initially directed at the lower end of the sleeve 38 adjacent the base section of the frame member 29 and progressively moved toward and at least to, if not beyond, the upper end of the frame member 29. The sleeve 38 in shrinking about the ribs 32 and against the mandrel will shrink to substantially the configuration shown in cross section in Figure 18. The upper end portion of the film sleeve 38 will shrink about the ring halves 33 substantially as shown in Figure 13 and a small annular remnant portion 40 which may remain will be formed against the mandrel. After the heat shrinkable film has cooled and the mandrel has been removed, the container is complete and ready to receive soil, and seed or a cutting of the plant desired to be grown herein. As described for the other embodiments of the invention, the sleeve 38 may be provided with weakening lines and/or finger tabs to aid in removing the sleeve 38 immediately prior to planting the frame member by means of a tool such as the tool of Figure 19.

70 In the alternative, the sleeve 38 may be made from a sheet material with two edges joined by a waterproof tape. Further in the alternative, the sleeve 38 may be formed of a heat shrinkable film material, and shrunk about an appropriately shaped mandrel, cooled, removed from the mandrel and thereafter slid over and effectively snapped onto the frame member 29.

75 One form of tool for planting the frames and plants growing therein is shown in Figures 19 to 22 at 41. End 42 is the planting end of the tool 41 and end 43 is the tamping end of the tool 41. The tool 41 may be formed of a tubular steel stock, and in the alternative the ends may be of tubular steel while an intermediate portion is of wood.

80 The planting end 42 must be tubular for a distance sufficient to receive the shank section of the container frame member therein. If the tubular planting end 42 is provided with a longitudinal slot in one wall thereof so that part of the top growth of the plant may extend outwardly of the tool, the planting end 42 may be additionally tubular only for a distance sufficient to allow the stem portion of the plant to curve outwardly of the slot without breaking. If the top growth of the plant is to be completely inserted into the tool 41, the planting end 42 must be additionally tubular for a distance sufficient to receive the top growth of the plant therein. The internal diameter of the planting end 42 is substantially equal to the outer diameter of a cross section of the shank section of the frame member. Usually, the shank section of the frame member will be loosely frictionally retained

(17)

within the planting end 42 of the tool 41 so that when the tool 41 is rotated from the position shown in Figure 19 to that shown in Figure 20, the frame member and plant growing therein will not fall from the planting end 42. However, under some conditions it may be desirable to form a projection on the outer lower end of one or more of the ribs of the shank section of the frame member to produce further frictional retention of the shank section within the planting end 42 of the tool 41.

The outer diameter of the printing end 42 of the tool 41 is less than the upper outer diameter of the base section of the frame member. Thus, the free edge of the planting end 42 will engage the annular shoulder of the base section of the frame member. Hence, when the tool 41 is held by a person as shown in Figures 20 and 21, foot pressure applied by the person to the crossbar 45 of the tool 41 will cause the planting end 42 to project the base section and shank section of the frame member into the ground.

A stop 46 is provided on the planting end 42 of the tool 41. In the embodiment shown, the stop 46 is fixedly secured on the planting end 42 a distance from the free edge of the end 42 substantially equal to the length of the shank section of the frame member. If desired, the stop 46 may be mounted by any well-known means (not shown) on the planting end 42 so as to be selectively positionable at different longitudinal position on the planting end 42 to provide for different planting depths of the frame member, and particularly to accommodate frame members having different shank section lengths.

When the frame member is planted in the ground with the plant therein, it is without the sleeve, so as to expose the growing medium and root mass between adjacent ribs of the shank section directly to the soil in which the frame member has been planted. Thus, the laterally growing roots of the plant within the shank section may grow outwardly into the adjacent soil as the plant continues to grow in its planted location. As the roots of the plant increase in size, and grow into the adjoining soil, the ribs of the shank section will be pushed out of the way or otherwise fractured and destroyed by the constantly increasing root mass.

In the process of planting the container without the sleeve member, a number of different arrangements may be provided for removing the sleeve member. When the person is holding the container as shown in Figure 19, the sleeve may be moved against a sharp instrument carried either by the person or on the tool 41, to cut, tear or otherwise strip the sleeve from the frame

before the frame member is inserted into the planting end 42 of the tool 41 in a manner as shown in Figure 19. Of course, in those instances where the sleeve is provided with a tape or pull tab, the person may merely pull the sleeve from the frame member by that means.

After the frame member is planted, as shown in Figure 21, the planting end 42 is withdrawn from the ground to leave the frame member and plant in the ground. The tamping end 43 of the tool 41 may be used to tamp the soil about the frame member to ensure that the space in the ground previously occupied by the planting end 42 of the tool 41 is obliterated. In the use of a tool without a tamping end 43, a person may merely tamp the soil about the plant with his foot.

In addition to manual planting of the frame members and plants growing therein as described above, appropriate machines may be used to mechanically plant the frame members where the planting site permits machine planting and large numbers of frame members are to be planted in repeating patterns.

It is desirable to locate the sleeve 11, 24, or 38 so as to ensure that the drain openings 15, 25, or 39 are neither too large nor too small in vertical dimension. We envisage a number of different arrangements. One is by the tucking in of the upper end of the sleeve as at 26 in Figure 8. When the sleeve is made of a heat shrinkable material, it may be heat shrunk on a mandrel or on the frame to form the configuration of the sleeve shown in Figure 13, and that configuration will interlock with the ring halves 33 to properly locate the lower end of the sleeve to form the drainage openings. When the sleeve is not made of a heat shrinkable material, it may be properly located and adhered to the ribs by a water-soluble adhesive. Further, if desired or necessary, locating shoulders or bosses can be provided on the outward sides of the lower ends of the ribs to properly locate the sleeve.

After the sleeve has been removed, it is expected that with a frame member such as shown in Figures 1 to 5 a person may hold the ribs against the growing medium and root mass until he inserts the frame into the ground in the transplanting operation. Further, temporarily a string or rubber band could be applied about the ribs, but any such aid should be removed after the frame is planted. It is further possible that a person may use some type of temporary clamp about the frame member of Figures 1 to 5 when the sleeve is removed and the frame is planted. In the embodiment of Figures 6 to 10, it is expected that the ribs will have sufficient integrity to adequately hold the growing medium and root mass. In the em-

bodiment of Figures 11 to 18, the ring halves 33 may be secured together by a degradable adhesive that would disappear before the stem of the plant grows large enough to be restricted in its further growth by the ring. We further contemplate that in some embodiments of the frame of Figures 11 to 18, the ring halves 33 themselves, and possibly the ribs, may be made of a degradable material that will break down and substantially disappear as the plant grows to maturity.

WHAT WE CLAIM IS:—

1. A container in which a plant may be planted and grown, said container comprising the combination of a frame member and a removable sleeve, said frame member comprising a base section having a closed upper surface devoid of any openings capable of passing water therethrough, and a plurality of ribs secured at their lower ends in a spaced-apart relationship about the periphery of said base section such that the longitudinal axes of the ribs upstand therefrom, said sleeve being formed in a substantially tubular shape from flexible sheet material, said sleeve being mounted about and supported by said ribs, the lower edge of said sleeve being spaced from the periphery of said base section to provide drainage openings therebetween.

2. A container as defined in claim 1, and said base section including a depending portion having a ground penetrating outer configuration.

3. A container as defined in claim 1, wherein said closed upper surface of said base section is convex upwards to define a surface which directs the roots of any plant growing downwardly thereagainst in directions downwardly and radially outwardly toward the periphery of said base section.

4. A container as defined in claim 3, wherein said closed upper surface is cone-shaped.

5. A container as defined in claim 3, wherein said closed upper surface is pyramidal.

6. A container as defined in claim 5, wherein said pyramidal surface is four-sided, said plurality of ribs being four in number, and each of said ribs being positioned on the periphery of said base section to intersect a line of intersection of two adjacent sides of said four-sided pyramidal surface.

7. A container as defined in claim 6, wherein each of said ribs is formed to have two longitudinal walls which converge radially inwardly of said container substantially to an axially extending line, the lower end of which intersects said line of intersec-

tion of two adjacent sides of said four-sided pyramidal surface.

8. A container as defined in claim 1, wherein one longitudinal strip section of said sleeve is adapted to be separated from the remainder of the sleeve for opening said sleeve longitudinally thereof to remove said sleeve from said ribs.

9. A container as defined in claim 2, wherein each of said ribs is arcuate in transverse cross section and lies within a circle smaller in diameter than the outer diameter of the upper end of said base section.

10. A container as defined in claim 2, wherein the upper end of said base section radially outwardly of said ribs comprises an annular shoulder formed to receive a tubular planting tool thereon for inserting said container, after removal of said sleeve, in the ground.

11. A container as defined in claim 10, and including a ring on the upper ends of said ribs, and the upper end of said tubular sleeve extending circumferentially about said ring.

12. A container as defined in claim 11, wherein said ring is a circumferentially discontinuous ring.

13. A planting method for a plurality of plants using a plurality of containers as defined in claim 10, comprising the steps of placing a growing medium and a plant seed or cutting in each of said plurality of containers and growing said plants therein, thereafter transporting said plurality of containers to a transplanting site, removing the sleeve from one of said containers and insert said frame member in a planting tool having a tubular section at one end capable of accepting said frame member with the ribs longitudinally within the tubular section and with the free edge of said tubular section abutting the annular shoulder on said base section, pushing said tubular section into the ground until said ribs are within the ground, and withdrawing said tubular section to leave said frame member with the plant growing therein in the ground, tamping the ground about said planted frame member, and thereafter repeating the foregoing steps for the remaining containers, from the step of removing the sleeve from one of said containers.

14. A container as defined in claim 1, substantially as described with reference to Figures 1 to 5, Figures 6 to 10, or Figures 11 to 18 of the accompanying drawings.

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bodiment of Figures 11 to 18, the ring halves 33 may be secured together by a degradable adhesive that would disappear before the stem of the plant grows large enough to be restricted in its further growth by the ring. We further contemplate that in some embodiments of the frame of Figures 11 to 18, the ring halves 33 themselves, and possibly the ribs, may be made of a degradable material that will break down and substantially disappear as the plant grows to maturity.

WHAT WE CLAIM IS:—

1. A container in which a plant may be planted and grown, said container comprising the combination of a frame member and a removable sleeve, said frame member comprising a base section having a closed upper surface devoid of any openings capable of passing water therethrough, and a plurality of ribs secured at their lower ends in a spaced-apart relationship about the periphery of said base section such that the longitudinal axes of the ribs upstand therefrom, said sleeve being formed in a substantially tubular shape from flexible sheet material, said sleeve being mounted about and supported by said ribs, the lower edge of said sleeve being spaced from the periphery of said base section to provide drainage openings therebetween.

2. A container as defined in claim 1, and said base section including a depending portion having a ground penetrating outer configuration.

3. A container as defined in claim 1, wherein said closed upper surface of said base section is convex upwards to define a surface which directs the roots of any plant growing downwardly thereagainst in directions downwardly and radially outwardly toward the periphery of said base section.

4. A container as defined in claim 3, wherein said closed upper surface is cone-shaped.

5. A container as defined in claim 3, wherein said closed upper surface is pyramidal.

6. A container as defined in claim 5, wherein said pyramidal surface is four-sided, said plurality of ribs being four in number, and each of said ribs being positioned on the periphery of said base section to intersect a line of intersection of two adjacent sides of said four-sided pyramidal surface.

7. A container as defined in claim 6, wherein each of said ribs is formed to have two longitudinal walls which converge radially inwardly of said container substantially to an axially extending line, the lower end of which intersects said line of intersec-

tion of two adjacent sides of said four-sided pyramidal surface.

8. A container as defined in claim 1, wherein one longitudinal strip section of said sleeve is adapted to be separated from the remainder of the sleeve for opening said sleeve longitudinally thereof to remove said sleeve from said ribs.

9. A container as defined in claim 2, wherein each of said ribs is arcuate in transverse cross section and lies within a circle smaller in diameter than the outer diameter of the upper end of said base section.

10. A container as defined in claim 2, wherein the upper end of said base section radially outwardly of said ribs comprises an annular shoulder formed to receive a tubular planting tool thereon for inserting said container, after removal of said sleeve, in the ground.

11. A container as defined in claim 10, and including a ring on the upper ends of said ribs, and the upper end of said tubular sleeve extending circumferentially about said ring.

12. A container as defined in claim 11, wherein said ring is a circumferentially discontinuous ring.

13. A planting method for a plurality of plants using a plurality of containers as defined in claim 10, comprising the steps of placing a growing medium and a plant seed or cutting in each of said plurality of containers and growing said plants therein, thereafter transporting said plurality of containers to a transplanting site, removing the sleeve from one of said containers and insert said frame member in a planting tool having a tubular section at one end capable of accepting said frame member with the ribs longitudinally within the tubular section and with the free edge of said tubular section abutting the annular shoulder on said base section, pushing said tubular section into the ground until said ribs are within the ground, and withdrawing said tubular section to leave said frame member with the plant growing therein in the ground, tamping the ground about said planted frame member, and thereafter repeating the foregoing steps for the remaining containers, from the step of removing the sleeve from one of said containers.

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