

1,096,116.

Patented May 12, 1914.

2 SHEETS—SHEET 1.

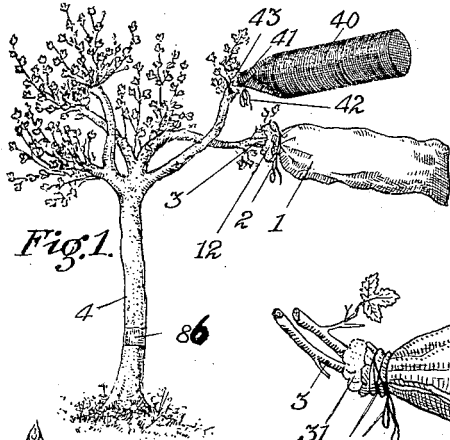


Fig. 1.

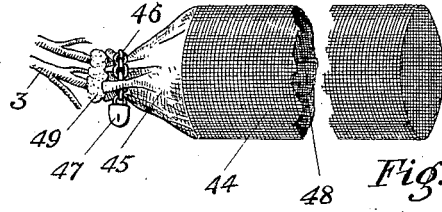


Fig. 5.

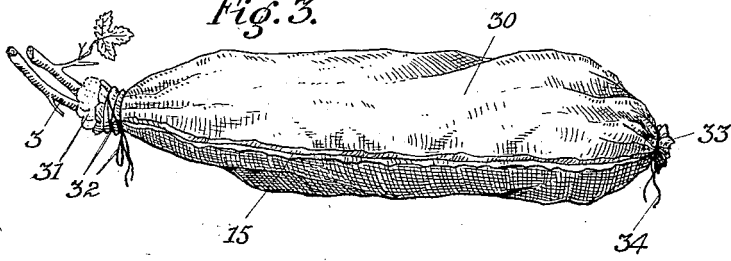


Fig. 3.

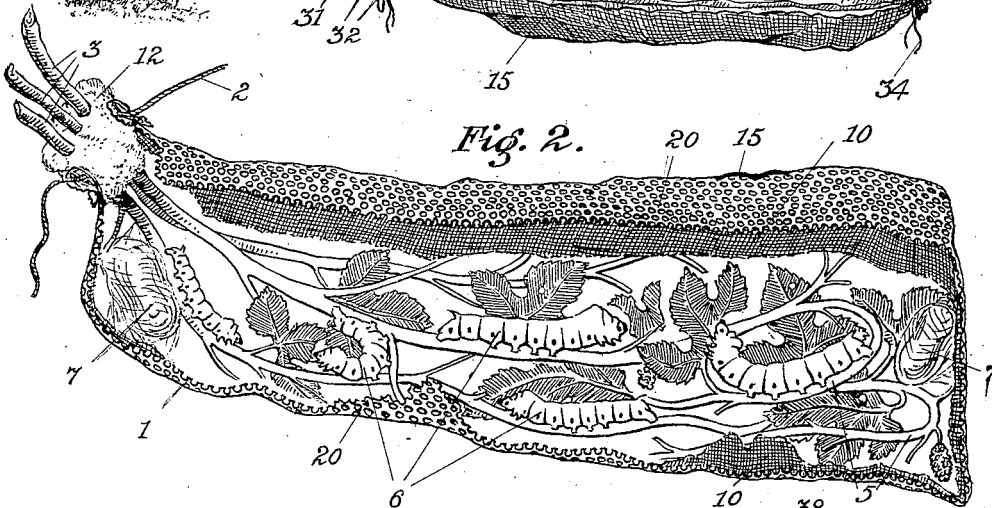


Fig. 2.

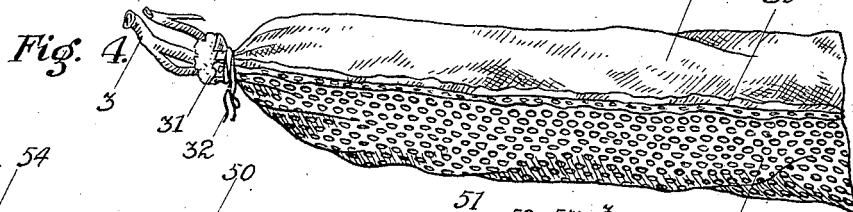


Fig. 4.

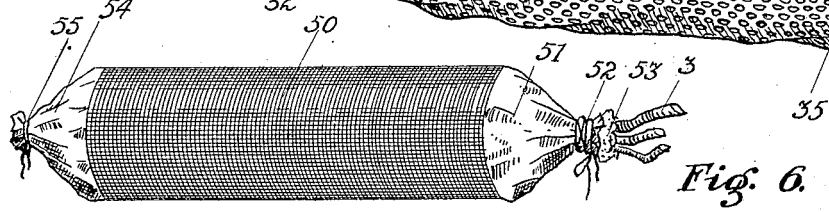


Fig. 6.

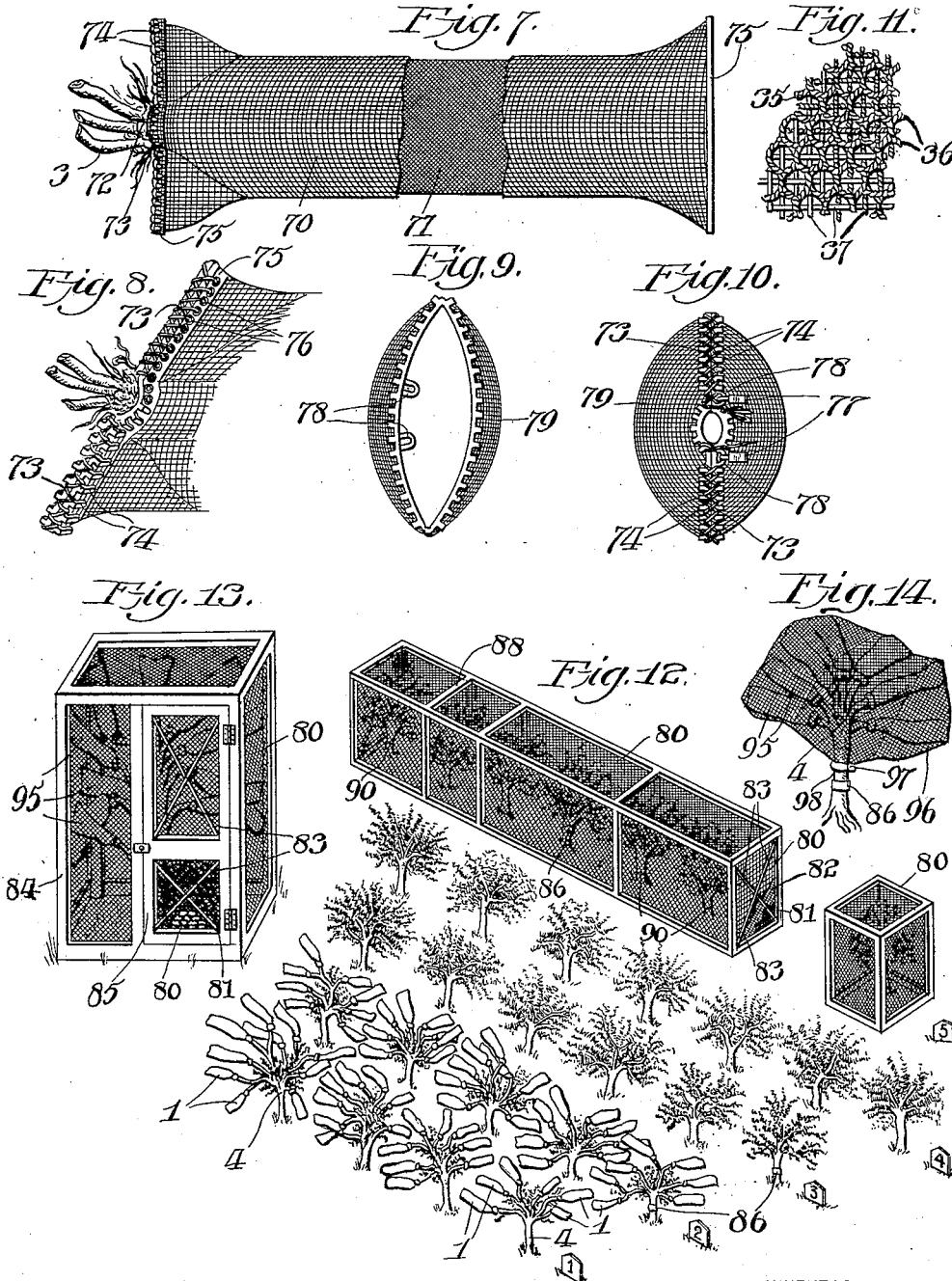
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# UNITED STATES PATENT OFFICE.

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## SERICULTURE.

1,096,116.

Specification of Letters Patent.

Patented May 12, 1914.

Application filed October 29, 1910. Serial No. 589,746.

*To all whom it may concern:*

Be it known that I, MARVIN H. MEAD, of Passaic, New Jersey, have invented certain Improvements in Sericulture, of which the following description, in connection with the accompanying drawings, is a specification, like numerals on the drawings designating like parts.

This invention relates to agriculture, and more particularly to husbandry, and my improvements are of notable utility when applied to sericulture, although I contemplate their utilization in any field to which they are adapted by their nature.

An important object of my invention is to provide an improved method of, and apparatus for, the "education" of the filament-producing *Lepidoptera*, of which the "silkworm" of commerce is at present the most conspicuous example, the term "education" being used herein as a conveniently brief designation for treatment of the silk-worm during that period in its life subsequent to hatching and eventuating in the formation of the cocoon, and the term not being limited to any narrow technical significance.

My improved method comprises as an important feature the exposure of the silkworm, during this developmental and productive portion of its career, to environmental influences which will tend to render its constitution hardy, and therefore resistant to disease; also to provoke a robust appetite for that food best qualified to furnish it with material of the properties requisite to the production of a filament possessing great tensile strength, luster, and elasticity, and further, to stimulate the silk-worm, when it has attained healthy maturity, to exert its vigor to the utmost in the rapid and steady formation of a cocoon capable of yielding to the reeler a filament of uniform diameter, elastic, fine, and without the numerous joints which characterize the output of silk-worms educated as at present.

Heretofore, the many diseases of the silkworm, incidental to its domestication through thousands of years, have been combated, not by a true prophylaxis, as in my improved method, but by costly and wasteful destruction of millions of eggs preceded by unremitting microscopic examination of the eggs by thousands of experts whose remuneration constitutes a large factor in the expense of rearing the silk-worm.

Another expense item of large proportions is incurred by the collection of enormous quantities of mulberry leaves, brought to the silkworms hatched from the eggs surviving the examination, after which the "education" of these silk-worms has been deemed unanimously by experts to require that the silk-worms be reared in artificially heated rooms, with unceasing precautions against undue changes of temperature, and also that they shall receive an attendance which at times must be unremitting, day and night, owing to the voracity of the developing worms, the menial requirements incidental to maintenance of sanitary conditions in their work-rooms, and the necessity for preparation of artificial supports of twigs into which the silk-worms ascend to spin their cocoons. At best, the leaves thus supplied are lacking in freshness, and the entire method of rearing proceeds on a false theory, for the silk-worms thus pampered are lacking in the vigor necessary to their proper development and functioning, so that their silk lacks luster, fineness, elasticity, strength, uniformity of diameter and continuity. Furthermore, in proportion as attention to the above recited details of treatment flags, the product falls still farther below market standards, so that while the highly developed industry of silk-growing in France has suffered seriously from the expenses of modernized sericulture, on the other hand the industry in China has, under lax methods, deteriorated at times to such an extent that only seven per cent. of the cocoons could be converted into raw silk of a marketable quality.

Accordingly, my method contemplates the exposure of the silk-worms to the open atmosphere, with its considerable changes of temperature, varying moisture conditions, and hail, rain and thunderstorms, and furthermore I force the silkworms to find their own food on the growing plant life which best furnishes it, preferably the leafy branch of a mulberry tree itself, in which in due time they find an ample base for spinning their cocoons, and where they fulfil a vigorous career requiring no attention until the cocoons are ready to be gathered. To make possible this novel domestication of the silkworm in its natural habitat, I have discovered that it is important to protect it from rapacious parasites, and I have devised suit-

able apparatus to effect this purpose, in accordance with which I provide for the confinement of the silkworms upon growing trees or plants in inclosures preferably constituting artificial nests, of a size and material suitable to contain a considerable number of silk-worms constituting a colony, not too numerous however, to effect the comfort, or limit the food supply, of its individual members.

It is not the habit of silk-worms to spin or construct a nest for the confinement and protection of a considerable colony of silkworms, and I have observed that during the education of the silkworm it is so weak that when it falls from the leaf upon which it has been feeding, a frequent occurrence, the silkworm can only regain its position upon the branch with the greatest difficulty, even where the distance to be traversed is less than a yard, and if the silkworm must travel a distance greater than a yard to regain its feeding position, many a silkworm will fail to reach food and will starve to death. Accordingly, I prefer to provide an inclosure having at least one wall in close proximity to a branch of the growing plant, and affording an easily traveled path to the leaves, so that a silkworm which has fallen from its feeding position to the wall of the inclosure can readily regain the leaf, and will thus not only be prevented from starving, but will not suffer any impairment of strength likely to affect unfavorably the quality and quantity of its product.

Under favorable conditions, use may be made of outer inclosures sufficient in size to contain one or more trees, and of material such as wire netting or wire cloth of sufficient strength and suitable mesh to exclude such enemies as birds, wasps and even smaller insects, while inner inclosures will preferably be provided to serve as artificial nests, ordinarily, to confine the workers within easy reach of the growing plant food, unless the practice of my improved method develops a race of silkworms hardy enough to regain feeding position upon the branches of a tree from which they have fallen to the ground, in which event the large inclosure alone may serve, if made of material suitable to confine the silkworms and exclude all enemies from which such an inclosure can protect them. Ordinarily, however, the inclosure or containing means will preferably be of a size only sufficient to inclose snugly one or a few branches having leaves enough, with their natural growth, to support the life of the entire colony without change until the cocoons are formed, and any suitable apparatus may be utilized to furnish such inclosure. As one convenient device for this purpose, I prefer to provide an artificial nest formed of a woven fabric, or a netting, gauze or reticulated fabric of

metallic or non-metallic material, in the form of cylinders or cylindrical pouches provided with means to close all avenues of escape of which the silkworms might otherwise take advantage and through which their enemies might gain ingress. I prefer also to provide a plurality of layers of inclosing material, as for example, by superimposing the layers one upon another, or by using a plurality of separate pouches forming these layers of different materials each suited to the particular use it is designed to serve, or I may utilize a novel fabric which I have devised for the purpose, having a mesh of special form calculated to resist enlargement of the mesh by larger insects and at the same time small enough to exclude the smaller insects. For example, where several layers are provided, I may use, as the interior layer, material such as a stout organdie, of a mesh that will not exclude air, but will serve to exclude all insects and thus avoid the parasites originating with such insects as Uji flies, whose habit it is to lay eggs in the body of the silkworm. These flies are common, and great loss to the silk industry in Japan has been occasioned by their ravages. If made of a sufficiently stout material, such as pure, raw silk, a container consisting of a single layer may suffice, but, where found desirable, another layer may be of a material having a larger mesh than the first, as for example, a woven or netted cotton fabric such as bobinet, of sufficiently stout thread to keep out large insects such as wasps, and the smaller birds, having a mesh of say one-sixteenth of an inch in diameter. Still another layer may be formed as a cylinder or screen of wire-cloth, preferably of a light and relatively non-oxidizable metal such as aluminum, or a rustless fly screen material, and this would ordinarily be amply adequate to protect the colony it inclosed from the most vigorous showers of rain, hail or like destructive objects, for I have found in practice that even with only cloth pouches the colonies inclosed do not suffer from heavy showers of hail and rain; also that the silkworms thus protected are free from disease, are not affected deleteriously by sunshine or moisture, nor by observed changes of temperature ranging from 58° to 98° Fahrenheit, when the thermometer is shaded but the colony exposed to the sun and air. On the contrary, the life-history of these colonies is more normal, and their product much more perfect in every respect than is the case with worms reared indoors.

The various features of my invention will be illustrated and described fully in the accompanying drawings and specification and pointed out in the claims.

In the drawings, Figure 1 shows in perspective a plurality of containers in the con-

struction of which my improvements have been embodied, the same being shown in place upon the branches of a mulberry tree; Fig. 2 is a fragmentary detail view in vertical section, on an enlarged scale, of part of a container like one of the containers shown in Fig. 1, having its walls broken away to reveal clearly the several layers of material of which it is formed, and with several branches of the tree shown in elevation within the container, the silkworms being shown in feeding position; Figs. 3, 4, 5, 6 and 7 are views in perspective respectively of modified forms of container, which will be described in detail hereinafter; Figs. 8, 9 and 10 are detail views in perspective and side elevation, of containers of the type shown in Fig. 7, in open and closed positions, and with various forms of fastening devices; Fig. 11 is a fragmentary, detail view of an improved fabric constructed in accordance with my invention; Fig. 12 shows an orchard provided with inclosures of various forms; and Figs. 13 and 14 show separate trees, with individual inclosures, and having subsidiary containers.

In the embodiment of my invention selected for illustration and description to enable ready and complete understanding of my improved method, and disclosing a convenient form of apparatus by which the same may be put into practice, the part designated in Figs. 1 and 2 by the reference numeral 1 is a pouch of any suitable material, and is preferably provided with suitable means, such as the gather-string 2, to permit its mouth to be closed tightly about, and secured firmly to, one or more branches 3 of the growing plant 4 furnishing food for the workers, the plant 4 being shown as a mulberry tree, with a container 1 for silkworms.

The number of workers may vary as desired and found suitable, and workers of any suitable kind may be educated in accordance with my improved method, in accordance with which they are exposed to the outer atmosphere, with such ventilated means of protection as may meet the exigencies of particular installations.

In order to utilize the full capacity of the pouch 1 or similar inclosure, I may introduce therein a plurality of branches as indicated at 3 in Figs. 1 and 2, and preferably these branches will have their tips doubled back, as indicated at 5 in Fig. 2 to an extent which will permit growth of the branch in length, as I find that such growth will proceed sufficiently in spite of the reversal.

In the instance illustrated, the pouch 1 may be about three to four feet long, wide in proportion, incloses three branches 3 of corresponding dimensions, and the colony of workers 6 should consist of about thirty silkworms in the larval state, which may,

shortly after hatching, be introduced within the pouch at the time of its emplacement upon the branch, after which the pouch and its colony may be left in place until the cocoons 7 are ready for removal, say forty days later, and will preferably be so left, although if it be found desirable to transfer them to another bough, such transfer may be effected, with care, especially if delayed until after molting.

As already noted, a container may consist of but one layer, if made of sufficiently stout material, such as pure, raw silk, or a plurality of layers may be provided, as hereinafter described by way of example.

The container shown in Fig. 2 has a primary layer 10, of material similar to that already described with reference to Fig. 1, and which may be considered as organdie, in the instance illustrated, and in addition I have shown in Fig. 2 a secondary layer 20, preferably united, as by stitching 15, with the layer 10, to form a unitary pouch structure, and formed of such a fabric as cotton bobinet, with meshes about one-sixteenth of an inch in diameter, this pouch preferably having suitable packing material such as the cotton 12 surrounding the branches 3 within the drawstring 2, so that an insect-tight joint is formed at the throat.

In Fig. 3 I have shown a modified form of container 30 consisting of a pouch like that shown at 1 in Fig. 1, having a packing 31 at its throat, and a draw-string 32 for attachment, this pouch having also means to give access to the pouch without removal thereof from the branch or disturbing the draw-string 32. Any suitable device may be adopted for this purpose, and as one convenient form of device therefor, I have shown the inclosure 30 as capable of being opened at its end 33 also, having a draw-string 34 to close the gather. This may be loosened to remove debris from the inclosure, or when it is desired to gain access to it for other purposes.

To reduce the number of layers, securing at the same time exclusion of small insects, resistance to piercing and tearing by wasps or birds, and providing for ventilation, I have devised a novel material shown at 35, in Figs. 4 and 11, in which a mesh of stoutly woven material such as that indicated in Fig. 11 at 36, similar to bobinet, is crossed by lighter threads 37, double or single, which reduce the size of the mesh without impairing its strength and resistance to deformation, and without interfering with ventilation.

Under some conditions it may be found desirable to shield the workers from the direct access of rain or sunshine, and as one convenient means for this purpose I may form of canvas such portion of the container as may be suitable, as for example

the half 38 in Fig. 4. The amount of exposure can then be regulated by turning the container carefully on the branches without removing it. In Fig. 4, the numeral 31 indicates a packing, 32 indicates a drawstring, and 39 the seam.

In Fig. 1, 40 indicates a modified form of inclosure, which may be considered as a cylinder of aluminum, copper or iron wire cloth, secured suitably to the branch, as by simply wrapping the wire gauze around the limb as at 41 in Fig. 1, with a packing 43, and providing a drawstring, 42; or such a cylindrical nest may be provided as shown in Fig. 5 at 44 with a throat member 45 of canvas or other stout cloth having a draw chain 46 with a lock 47 to prevent tampering with the contents of the container. The container 44 may have an inner layer 48 of suitable fine-mesh material such as organdie, and may have a throat packing 49 of cotton similar in arrangement and purpose to the packing 12 in Fig. 1. Such a wire-cloth inclosure may take the place of the bobinet if its meshes are about the size of those in ordinary fly screen material, which I consider suitable for the purpose.

In Fig. 6 I have shown a wire gauze cylinder 50 having a throat 51, draw-string 52 and packing 53 similar to the corresponding parts described with reference to the container cylinder 30 shown in Fig. 3, and having at its other end a similar throat 54 with gather string 55, through which access may be gained to the interior without disturbing the attachment.

Other modes of attachment for cylinders of wire gauze may be adopted as required and as one form of such attachment I have shown in Fig. 7 the cylinder 70 preferably lined with suitable material such as organdie 71 and provided with a packing 72, and a lacing 73 engaged with a series of lacing hooks 74, the lacing being of suitable metallic or non-metallic material; the gauze may be turned upon itself several times, as illustrated at 75, to form a selvage, and eyelets 76 may be inserted to receive the lacing 73, as above in Fig. 8; so also auxiliary fastening devices such as the padlocks 77 coöperating with staples 78 may be provided, as in the modified container illustrated in Figs. 9 and 10, which is of wire gauze and similar to the container 70.

In brief recapitulation of the above recited modes of protection, a fine-mesh material such as organdie serves to keep the workers in, protects them from gnats, ants and other small insects, and affords a path to their food when they fall from the leaves. To protect them from foes which can tear or pierce the weaker material, it is desirable to provide a stronger defense, such as bobinet or wire cloth, in addition to the lighter material, or in place of it if the mesh be fine

enough, as the stouter material serves equally well to inclose the workers and affords even better ventilation.

As the outer or strongest layer of the inclosure is provided primarily for the exclusion of birds, wasps and other relatively large enemies of the silk-worm, I may form this inclosing member of sufficient size to inclose an entire tree, as illustrated at 80 in Figs. 12 and 13, and such an inclosure may be extended to cover a plurality of trees 90, suitable division walls 88 being provided, if found desirable.

Under favorable conditions, one or more of the inner layers of the inclosure may derive their support from this large inclosing members 80, as shown in Fig. 12 and on a larger scale in Fig. 13, in which the numeral 81 indicates a wall of organdie, while the reference numeral 82 in Fig. 12 designates a wall of bobinet, and these may be secured in place upon the wall 80 by any suitable means, such as the lashings 83. In Fig. 13, a supporting frame 84 is shown, with a door 85. Such large inclosures afford great freedom of movement to the operatives and to the silkworms, and may be employed to particular advantage when use is made of mulberry trees trimmed back to keep them small in order primarily to promote a constant putting out of fresh, nutritious leaves, and this practice also permits women or youths to reach the topmost branches without ascending the tree or mounting steps, so that cocoons can be readily gathered by reaching up from the ground, and the silkworms can be kept under observation, for the purpose of removing insects or other enemies which may be present in the inclosures.

In general, in carrying into effect my improved method of sericulture, it is well to shake the branches vigorously to dislodge such enemies as mosquitos, spiders, ants and wasps, immediately before introduction of the silkworms to the inclosures, and, by providing the trees and boughs with individual girdles of such adhesive substance as the composition used upon fly paper, many climbing enemies may be excluded. Such girdles are indicated at 86, in various figures.

Ordinarily, even where the inclosure of strong material is of a size sufficient to inclose one or more trees, I prefer to provide smaller subsidiary inclosures, containers or nests as indicated at 95 in Figs. 13 and 14, so that the workers may regain their feeding position quickly when they fall, and so that there may be the least possible chance of a gnat or similar enemy gaining access to the workers.

In Fig. 14, a net 96 surrounds the nests 95, and will preferably be tied to the tree at 97, with a packing 98 of suitable material,

such as cotton. The net 96 may be made of coarse material, such as bobinet, and the nests of finer material, such as organdie, or vice versa.

5 In case of drought, insufficiency of food, or unforeseen accident, the colony may be transferred to a fresh branch, and, this may be accomplished in any suitable manner. Preferably the bough will be cut and the colony  
10 transferred bodily.

In accordance with still another valuable feature of my improved method of sericulture, the inclosures may be arranged in predetermined series, and the silkworms of a  
15 given birth placed within certain of the inclosures. Thus, in the orchard shown in Fig. 12, the trees arranged in row 1 may receive the silkworms hatched on a Monday, while row 2 may receive Tuesday's hatching, and  
20 so on, and if the divisions of the orchard or of the nests (which may be designated 1, 2, 3, and so on, as indicated in Fig. 12) be extended to equal in number that of the days included in the period of education,—about  
25 forty—, at the end of the forty days cocoons may be gathered from the first container or containers in the series, and those containers released for receiving the silkworms of the forty-first day's hatching, thus providing for  
30 a continuous, recurrent cycle of operation through the season, which sometimes may reach one hundred and twenty days in favorable localities.

The sericulturist may utilize a much  
35 longer season, with my improved method of educating the silkworms confined upon growing plants in the open air, on account of the more robust condition engendered by their exposure, and he can also utilize the  
40 entire brood of silkworms hatched, and only rear for breeding purposes the number of moths required to produce substantially the exact number of eggs needed for seed, as there will be no diminution of the ovules nor  
45 of the silkworms by disease, and prolific sources of waste and uncertainty are thus eliminated.

Having illustrated and described my invention thus fully and suitable means by  
50 which it may be carried into effect, I wish it to be understood that I do not limit myself to the specific construction and materials shown and described by way of example, nor do I limit myself in general otherwise than  
55 as set forth in the claims read in connection with this specification.

I do not claim my method herein specifically, inasmuch as the same forms the subject matter of claims in my application

Serial No. 615,166, which has been divided 60 from this present application.

If the pouches be secured upon the branches early in the season, say in March, before the leaves begin to form, and before insects become active, the branches thus in- 65 closed will be kept free from insects from the start of the educational period, and the newly hatched larvæ may be readily introduced to the pouches at the proper season.

What I claim as new and desire to secure 70 by Letters Patent of the United States of America is:—

1. Apparatus for sericulture, comprising an artificial nest for a plurality of silkworms, formed of ventilated material of 75 sufficient strength to withstand deformation by said silkworms and their enemies, and having ventilating openings of suitable size to exclude parasite-producing enemies, with means to secure said nest in place upon a 80 growing plant embracing a leafy portion thereof sufficient to serve as food for said silkworms, the walls of said nest being arranged in juxtaposition with said leaves throughout its extent, so that said walls 85 serve as a short path to the leaves and the silkworms are prevented from injurious falls and fatiguing and fatal journeys in search of food.

2. Apparatus for sericulture, comprising 90 a flexible pouch formed of an inner layer of fine-mesh fabric and an outer layer of coarser strong mesh fabric, constituting together an artificial nest for a colony of silkworms, and means to secure said pouch in 95 place upon a growing plant, embracing a compact leafy portion thereof sufficient to serve as food for said silkworms, with the walls of said nest in juxtaposition with said leaves substantially throughout its extent, 100 serving to confine said silkworms on all sides in close proximity to their food, and to serve as a short path thereto if a worm falls from the leaves.

3. Apparatus of the class described; said 105 apparatus comprising a relatively large outer container to inclose a growing plant, and a plurality of inner artificial nests to inclose portions of said growing plant; substantially as described. 110

Signed at Passaic, in the county of Passaic and State of New Jersey this twentieth day of October, 1910.

MARVIN H. MEAD.

Witnesses:

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ALEXANDER C. PROUDFIT.