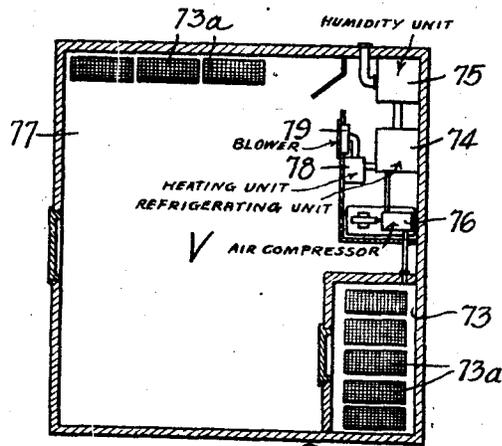


March 12, 1929.

G. D. HURST
METHOD OF AND APPARATUS FOR CONSERVING
COCOONS OF SILK PRODUCING INSECTS
Filed Sept. 20, 1924

1,704,972



Inventor
GLENN D. HURST

By *Munn & Co.*

Attorneys

UNITED STATES PATENT OFFICE.

GLENN D. HURST, OF LOS ANGELES, CALIFORNIA.

METHOD OF AND APPARATUS FOR CONSERVING COCOONS OF SILK-PRODUCING INSECTS.

Application filed September 20, 1924. Serial No. 738,886.

Silk-producing insects, particularly the Bombyx mori, or mulberry silk worm, are metamorphosing insects performing their life cycle in four changes, viz, the egg, the larvæ, the chrysalide and the adult or moth.

At the conclusion of the larval period, the insect spins a cocoon about its body, the natural purpose of which is to provide a protected place or housing in which to carry on the transformation from larvæ to moth. This cocoon is made by the insect drawing out of the ducts within its body a protein fluid, which coagulates upon exposure to the external environment into a fine filament. The larvæ spins this filament in loops and layers into the shell of the cocoon, until an insulating wall has been built up. The filament consists of an inner core called fibroin and an outer film or layer of gum called sericin. This outer layer of gum serves to bind the fibroin filaments together in the shell.

It is this filament which is recovered from the cocoon that provides the silk textile fiber.

In the art of making raw silk thread, the filament of a single cocoon is unraveled and forms one continuous strand. This strand or filament is united with other like filaments to make a composite or aggregate thread of sufficient strength for commercial use.

In the natural evolution of the insect to adult moth, the larva is transformed within the cocoon to a chrysalide, which is the rudimentary form of the adult moth. The chrysalide then continues its development to the adult moth, and the moth secretes a fluid which decomposes the filament wall of the cocoon and then emerges from the cocoon shell.

The emergence of the moth destroys the cocoon so far as the recovery of a continuous filament from the cocoon is concerned.

The practice of the industry for centuries has been to destroy the life of the insect in its chrysalide form by suffocating it with heat, so that the cocoon can be utilized for reeling. In this way the entire filament is recovered.

The application of heat for this purpose hardens the gum of the filament and produces many defects which are present in raw thread and are detrimental to the manufacture of yarns or fabrics.

It is the purpose of my invention to provide a method of conserving the cocoon for

reeling, which will preserve the filament in a state of freshness with all the native properties of tenacity, elasticity and lustre unimpaired. This is accomplished by arresting the development of the chrysalide to moth and then suspending this development.

Other objects and advantages will appear in the following specification, and the novel features of the device will be particularly pointed out in the appended claims.

My invention is illustrated in the accompanying drawing forming a part of this application in which

The figure shows a building in which an apparatus is disposed for arresting the development of the insects.

In order to arrest and then suspend the moth development of the cocoons immediately following the period of metamorphosis, and with the object of preventing the emergence of the moth from the cocoon shell and thus to conserve the cocoon in its native state with a fresh, unbroken filament for reeling into raw silk skein, I have provided a building V having walls which are insulated against heat so that the exterior temperature will have no effect on the interior temperature. This building is constructed to provide a hermetically sealed chamber 73 in which the temperature, humidity and pressure of air is controlled and maintained. A refrigeration unit 74 reduces to a predetermined degree the temperature of a current of air supplied thereto from a humidity unit 75 in communication with atmosphere and withdrawn therefrom at a predetermined and fixed volume and velocity by a mechanical air compressor 76, the air being ultimately delivered to the chamber 73 under a pressure which can be controlled to obtain and maintain a predetermined pressure in the chamber. Within the chamber 73 are hampers 73^a in which the cocoons are placed, the hampers being formed of wire screen, as indicated, to allow free circulation of air therethrough.

The building V is provided with a second and larger chamber 77 in which the cocoons are adapted to be stored after being removed from the chamber 73. In this storage chamber 77, the temperature, humidity and circulation of air is also controlled and maintained. For this purpose, a heating unit 78 communicates with the refrigeration unit 74

so as to increase the temperature of the air withdrawn from the latter and delivered to the storage chamber by a blower 79 in communication with the heating unit.

5 My method of arresting and suspending the development of the moth, following the period of "metamorphosis," is carried out with the above apparatus, and the method in its preferred embodiment is substantially
10 as follows:

During the period of pupation the larva has undergone a change in bodily structure which is completed by an invisible moult within the cocoon and at the conclusion of
15 which the insect emerges from the skin of the larva of its fifth age as a chrysalis. Upon completion of the metamorphosis, and before the process of transformation to the moth has progressed materially, I remove
20 the cocoons to the chilling chamber 73, where the cocoons are subjected to a chilling process in which the air is of a temperature of 40 degrees Fahrenheit. The cocoons are subjected to this chilled air under a pressure of
25 approximately six inches, as indicated by the measuring water column, for approximately one-half hour. This pressure causes the air to immediately penetrate the interstices of the cocoon mesh, and to arrest the develop-
30 ment of the chrysalis by rapidly reducing the temperature of the cocoon to the temperature of the chamber 77. The cocoons are then removed to the storage chamber in which the temperature is maintained at
35 degrees Fahrenheit, with a humidity of approximately 75 degrees of saturation and a circulation of new air, and in this environment the chrysalis remain dormant, and in this dormant state they are delivered to the
40 filature for reeling.

By the above method and the apparatus to make it effective, the last moult of the insect, in which the moth emerges from the envelope of the chrysalis and penetrates the
45 shell of the cocoon, is prevented, and the filament of the cocoon is preserved intact; the filaments of the cocoons are preserved in a state of freshness with all the native qualities that are commercially desirable unimpaired, namely, tenacity, elasticity, suppleness and lustre; the gummy covering of the
50 filament which fixes it in place in the mesh of the cocoon layers is also maintained in a condition of freshness, which, together with the preserved state of the filament, facilitates the process of reeling and results in
55 useful economies in working the filament from the cocoon into the raw silk skein with a minimum of defects.

60 Although I have herein shown and described only one main method of arresting the development of the silk worm, and only one form of apparatus by which the method can be performed, it is to be understood that
65 various changes in the method and appara-

tus can be made herein without departing from the spirit of the invention and the spirit and scope of the appended claims.

I claim:

1. A method of suspending the moth development of silk producing insects which
70 comprises the subjection of the cocoons for a predetermined period to cooled air under pressure sufficient to penetrate the cocoons and reduce the temperature of the chrysalis
75 sufficiently to arrest its development.

2. A method of suspending the moth development of silk producing insects which
80 comprises the subjection of the cocoons for a predetermined period to cooled air under pressure sufficient to penetrate the cocoons and reduce the temperature of the chrysalis sufficiently to arrest its development, and then subjecting the cocoons to constantly
85 circulating air at a predetermined increased temperature and predetermined humidity in which the functions of moth development are not resumed.

3. A method of suspending the moth development of silk producing insects which
90 comprises the subjection of the cocoons for a predetermined period to cooled air of a predetermined humidity, temperature and pressure, the pressure being sufficient to
95 penetrate the interstices of the cocoon and thus to rapidly chill the chrysalis to arrest its development.

4. A method of suspending the moth development of silk producing insects which
100 comprises the subjection of the cocoons to circulating air of regulated and predetermined humidity and of regulated predetermined temperature sufficiently low to chill the chrysalis and thus to arrest and suspend
105 its development.

5. A method of suspending the moth development of silk producing insects which
110 comprises the introduction of the cocoons at the conclusion of the period of pupation into an enclosure or chilling chamber, the sealing of the chamber so that a pressure of air may
115 be maintained therein, the introduction of air of predetermined temperature sufficiently low to arrest the development of the moth, and of a degree of humidity to prevent saturation of the silk filament, and the main-
120 tenance of these degrees of temperature and humidity under a predetermined low pressure, the exposure of the cocoons to these environments for a sufficient period of time to cause the temperature of the chrysalis to be reduced to approximately the
125 degree of temperature of the air within the chamber, the removal of the cocoons to a storage chamber when the chrysalis have been reduced in temperature to the predetermined degree, the maintenance within the storage chamber of a continued renewal of
130 fresh air of such a degree of temperature and humidity that the chrysalis will con-

tinue in a state of dormancy, the exposure of the cocoons to these environments for an indefinite period.

5 6. A method of suspending the moth development of silk producing insects which comprises the introduction of the cocoons at the conclusion of the period of pupation into an enclosure or storage chamber, the maintenance within the chamber of a continued
10 renewal of fresh air of such a low degree of temperature that the chrysales will be arrested in development and the said development will be indefinitely suspended, and of
15 such a degree of humidity that the filament of the cocoon will be held below the point of saturation, and the exposure of the cocoons to these environments for an indefinite period.

20 7. The herein described method of arresting and then suspending the moth development of cocoons immediately following the period of metamorphosis, and for preventing the emergence of the moth from the cocoon so as to conserve the cocoon in its
25 native state with a fresh, unbroken filament, which consists in placing the cocoons in a hermetically sealed chamber, while subjecting the same to the free action of humid air at a fixed temperature, velocity and volume,
30 and then removing the cocoons from said chamber and subjecting same to a treatment of refrigeration.

35 8. The herein described method of arresting and then suspending the moth development of cocoons immediately following the period of metamorphosis, and for preventing the emergence of the moth from the cocoon so as to conserve the cocoon in its native state with a fresh, unbroken filament, which

consists in placing the cocoons in a hermetically sealed chamber, while subjecting same to the free action of humid air at a fixed temperature, velocity and volume, and then removing the cocoons from said chamber and
40 subjecting same to a treatment of refrigeration in the presence of controlled temperature, humidity and air in circulation.

9. An apparatus for suspending the moth development of silk producing insects comprising a hermetically sealed chamber for
50 receiving the cocoons, and means for supplying chilled air under pressure to the chamber.

10. Apparatus of the class described, comprising a hermetically sealed chamber having means whereby temperature, humidity,
55 velocity and volume of air is controlled and maintained therein, a second chamber in which cocoons as same are taken from the first chamber, are adapted to be stored, and
60 means whereby temperature, humidity, velocity and volume of air are controlled in said second chamber.

11. A method of suspending the moth development of silk producing insects, which
65 comprises the subjection of the cocoons for a predetermined period to cooled air, which penetrates the cocoons and reduces the temperature of the chrysalis sufficiently to arrest its development.

70 12. An apparatus for suspending the moth development of silk producing insects, comprising a hermetically sealed chamber for receiving the cocoons and means for supplying chilled air under pressure to said
75 chamber.

GLENN D. HURST.