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PROCESS AND APPARATUS FOR THE MANUFACTURE OF ARTIFICIAL FILAMENTS

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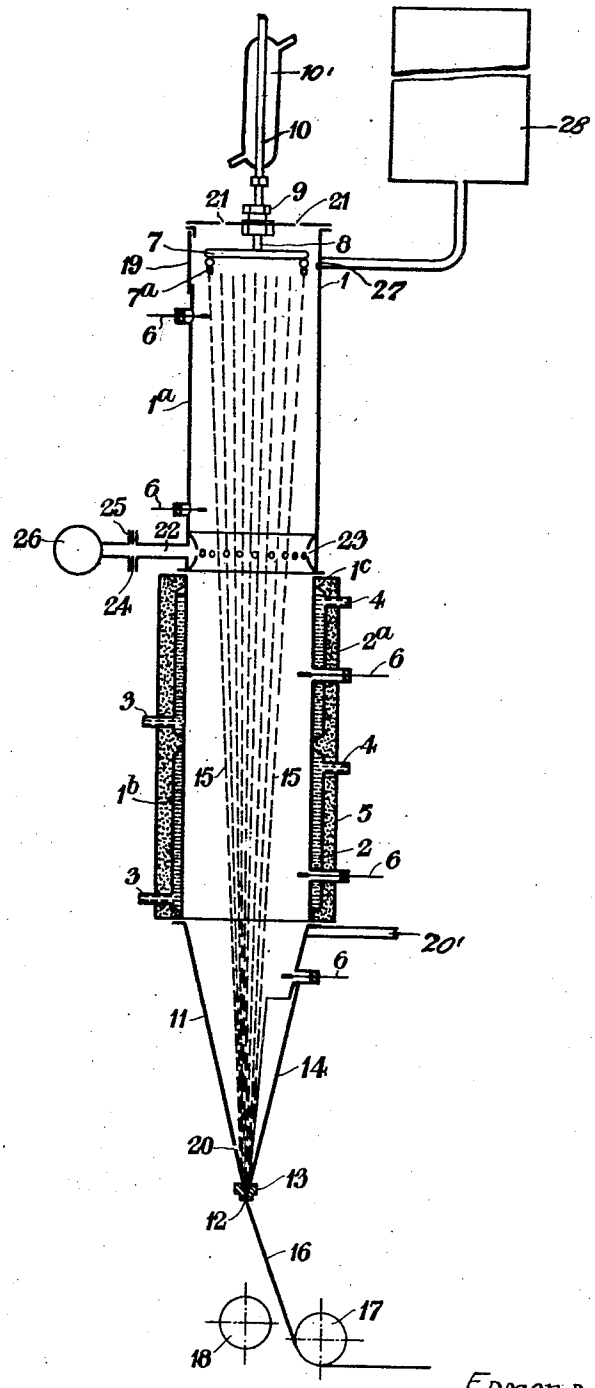

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UNITED STATES PATENT OFFICE

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PROCESS AND APPARATUS FOR THE MANUFACTURE OF ARTIFICIAL FILAMENTS

Application filed June 14, 1924, Serial No. 720,106, and in France December 21, 1923.

The present invention relates to improvements in processes and apparatus intended for the manufacture of artificial filaments of all kinds constituted either by a single fibre or by the union of several fibres, obtained by a flowing or spinning, in a gaseous medium, whether heated or not, of a more or less viscous fluid of suitable composition, comprising essentially:

(1) A solvent or solvent mixture (A), volatile in the operating conditions which are selected for spinning the said fluid.

(2) A body or mixture of bodies (B), suitably selected, non-volatile in the operating conditions adopted for spinning, which, when freed by evaporation of the liquid or mixture of liquids (A), constitutes the substance of the artificial filament issuing after spinning, (B) being constituted, for instance, by an ether, an ester, or another derivative of cellulose, alone, or mixed with other ethers, esters, or cellulose derivatives, or else by a derivative or mixture of derivatives of cellulose with substances adapted to impart plasticity or non-volatile solvents of the said derivatives. The mixture (B) may be, if desired, such as also to comprise in every one of the above cases one or more definite bodies, added for various purposes, which will remain in the completed filament or which will be subsequently removed, for instance, to dye it, dress, or finish it, or give it any required useful properties in view of its ultimate use.

In such processes, the spinning apparatus properly so-called is constituted by a cage or cell, closed or almost closed, inside which is placed, at one of its ends, the spinning device or die which comprises essentially apertures or orifices the number, shape, and diameter of which is adapted to the kind of threads or filaments which it is desired to manufacture, and at the other end the orifice or orifices for the exit of this or these threads or filaments.

Through the cell passes a current of air or other gaseous medium intended to enhance the evaporation of the solvent or solvent mixture and heated by any suitable means, either outside the cell or inside the latter, or both outside and inside, simultaneously, as has been described, for instance, in the case of downward spinning only, in my pending application Serial No. 667,872, filed October 11th, 1923.

As has been described in the above mentioned application, the heating may be arranged, or be performed, in such a manner as to obtain a suitable uniform temperature for the whole of the inside of the cell, or, on the contrary, to obtain different temperatures at different levels in the cell, for instance, in such a way as to have a lower temperature at the spinning device, so as not to affect the proper working thereof.

The process most generally used consists in passing through the cell, heated or not as the case may be, the evaporating gaseous medium, either already warmed or merely at ordinary temperature, the said medium entering by the outlet orifice or orifices of the thread or threads or filament or filaments, or by openings provided in the portion of the walls or the cell which is in the vicinity of these orifices. The gaseous current will then pass through the cell, will become loaded with the vapours of the solvent or solvent mixture (A) and issues from the cell by the opposite end of the latter, that is, that nearest the spinning die or dies.

Care is taken to maintain all the conditions obtaining during the spinning as constant and regular as possible by any suitable means, and, particularly, to regulate the rate of flow of the selected gaseous medium and its heating, whether before entering or inside the cells, in as uniform a manner as possible.

In spite of these precautions, the spinning is often unsteady, that is, the elementary fibres break frequently inside the cell. This unsteadiness is the cause of important supplementary expense, not only owing to the labour necessitated by the operation of gathering the broken elementary fibre or fibres and again joining them, when required, to the other fibres forming the manufactured filament or filaments, but also by the perturbations which are caused by this operation in the spinning and the proper recovery of the solvents. This drawback increases, of course, when the fibres which it is desired to

obtain become very fine and have thereby less resistance, or when it is sought to increase the speed of spinning, thereby increasing the efforts to which the fibres are subjected.

The unsteadiness of the spinning has therefore the further objectionable effect of either preventing the manufacture of threads or filaments formed of very fine elementary fibres, or compelling a reduction of the speed of spinning, which diminishes the output of the plant and increases therefore the cost of production.

The arrangement described in my above mentioned pending application does away with, or diminishes, the drawbacks of the unsteadiness, but does not improve the steadiness of the spinning itself.

An efficient regulation of the heating and of the rate of flow of the gaseous medium improves considerably the steadiness of the spinning in an industrial installation. It does not, however, remove all the causes of rupture of the fibres.

I have made the very important observation that one of the principal, if not the principal, cause of unsteadiness in spinning resides in the fact that in all the processes hitherto known, the temperature of the medium in the vicinity of the spinning dies is relatively high. In order to facilitate the evaporation of the solvent, this medium is heated, as has been mentioned above, in such a manner that the manufactured thread or threads, filament or filaments, issue from the cells with the necessary degree of dryness.

Although part of the heat so supplied to the gaseous medium is absorbed in the evaporation of the volatile solvent or solvents used, there remains generally in the said medium a notable excess of heat, so that its temperature at the exit from the cells is always higher (notably higher in some cases) than the external temperature.

An elevation of the temperature in the vicinity of the spinning dies has for its effect to diminish to a rapidly increasing extent the viscosity of the solution being spun, and, therefore, the resistance of the fibre being formed, which still contains all or most of the volatile solvent or solvents (A).

This drop in the resistance has an obvious connection with the rupture of the fibre or fibres, particularly when the spinning takes place near the practical limit of resistance, that is, when these fibres are very fine or when the speed of spinning is high.

According to the present invention, the steadiness of the spinning is increased, or, what comes to the same thing, finer fibres may be spun or a higher speed of spinning may be adopted with the same steadiness and therefore products of superior economical value may be obtained in the best conditions as to cost of production, by lowering the temperature in the vicinity of the spinning dies.

This lowering of the temperature may be obtained in any suitable manner, and particularly by the following means, which may be combined in any proportion and in any desirable manner:

(1) The spinning fluid may be cooled down to a temperature as low as may be desired, by any known method, either before it reaches the spinning dies, or in the immediate vicinity of the latter, or both these courses may be used simultaneously.

(2) A suitable cooling arrangement may be placed in the cell or outside the latter, in the vicinity of the spinning dies, the cooling being obtained by any suitable process such as, for instance, by providing the wall, if thermally conducting, with cooling ribs or any other device adapted to radiate heat or by providing a jacket in which a cooled fluid is caused to flow, or else by placing in the cell coils, ribbed tubes or other radiating devices in which flows a cold fluid, or by means of several or all of the above processes.

(3) The length of the cells may be increased in the direction of the spinning; this will allow, all other conditions remaining the same, the diminishing of the maximum temperature to which the gaseous medium employed must be brought, and therefore also the temperature at which this medium issues from the cells.

(4) The drying medium may also be introduced in the cell in the vicinity of the spinning dies, it may be exhausted near the exit of the threads or filaments from the cell, the medium being, or not being, heated in the whole of the region of the cell which is adapted for the drying.

(5) Lastly, the desired result may be obtained by causing the gaseous medium loaded with the volatile solvents to issue from the cell at a region suitably chosen, intermediate between the spinning dies and the exit of the threads or filaments. The admission of the gaseous medium may then take place either by the region where the threads issue from the cell, or by the region near the spinning dies, or by both regions simultaneously. In this latter case, one can admit the same medium at these two regions, or gaseous media of different composition and temperature may be admitted at each region. The cell may be, or may not be, heated at any suitable portion.

Preferably the atmosphere introduced in the vicinity of the spinning dies is cold or is at ordinary temperature. It may, however, be introduced at any suitable temperature for any desired purpose.

I have, as a matter of fact, discovered that this procedure presents the following important practical advantages:

It is easy to obtain or to select, for intro-

ducing it in the neighbourhood of the spinning dies, a gaseous medium the temperature of which is strictly uniform, or only undergoes slight variation over long periods of time. It is so, for example, if the said gaseous medium is the atmosphere of the spinning shed itself, or if it is heated or cooled in a suitable manner.

As, on the other hand, care will be taken to maintain all the other conditions obtaining while spinning constant or nearly constant, the spinning will be performed under remarkably uniform conditions and, therefore, the elementary fibres will be of very uniform dimension and quality.

Such a result cannot be obtained with the spinning processes hitherto used, whatever care may be bestowed upon the factors influencing the spinning. For instance, the temperature of the medium in which the spinning process takes place, that is, the temperature at which the gaseous medium issues from the cell, is subjected, in those processes, to variations which are slight, but which are erratic and of short periods, due, for instance, to variations in the rate of flow of the fluid to be spun, or of the gaseous medium used, the latter being then more or less cooled owing to the heat absorbed by the evaporation of the solvent or solvents or to variations in the degree of dryness of the fibres due to any cause, or to variations inherent to the heating systems usually employed, whether carried out within the cell or outside the latter, or, most frequently, to variations arising out of all the above causes simultaneously. The results of these variations are irregular variations of short period in the standard of the manufactured threads or filaments. On the other hand, threads or filaments obtained by means of the arrangement which I have discovered, tested by the same apparatus, have proved to be much more regular, and this even when, all other conditions remaining the same, the rate of flow of the gaseous medium used for the drying of the threads or filaments and entering by the orifices for the exit of said threads or filaments, or in the vicinity of these orifices, was allowed to vary between wide limits.

Without excluding any of the above-mentioned devices for the cooling of the gaseous medium in the vicinity of the spinning dies, and even if it were not desired to submit the said region of the cells to any cooling, it is preferred, for the above-mentioned reason, to cause the gaseous medium to leave the cell at a region intermediate between the spinning dies and the exit orifices of the threads and filaments, and to introduce in the cell, simultaneously, by the portion near the said exit orifices and that in the vicinity of the spinning dies, either the same gaseous medium, or two different gaseous media, which may be at the same or at different temperatures.

Concerning the gaseous medium introduced by or in the vicinity of the exit orifices of the threads or filaments, it may be brought in any manner to any desired temperature, before its admission to the cell. It may be preferable, however, to introduce it cold in the cell, for, by operating in this manner, and if the length of the cell is sufficient, not only the manufactured threads or filaments will leave the cell with the desired degree of dryness, but they will moreover issue from the cell as cold as possible. This has several practical advantages, among which may be mentioned the decrease of intensity of the objectionable electrification phenomena which usually take place during spinning of cellulose derivatives.

It will be understood that my invention is applicable to most varied types of cells, either isolated or united in groups more or less important, and whatever may be the manner in which they are constituted, the number or the form of the threads obtained in each cell or of the elementary fibres of each thread or filament, and the nature of the cellulose derivative, of the solvent or solvent mixture or of the various additive substances employed.

It is applicable just as well if the spinning takes place downwards in the cells, or upwards or in any other manner, and it is obvious that any treatment may further be applied to the manufactured threads or filaments after they have issued from the cell or cells. The arrangements adapted to carry it out may be of any suitable description. Preferably, the inlets for the air or for the selected gaseous medium, and which may be, or not, adjustable, are regularly distributed so as to distribute the gaseous stream in the best possible manner. The same applies to the outlet orifices for this medium, the exhaust taking place so as to avoid carrying away the elementary fibres, which are very light, by one or several openings, or also, for instance, by means of a collector surrounding the cell, as described in the example hereafter, or by any other distributing system having the same purpose.

The distance provided between this exit, on the one hand, and the spinning dies or the exit orifices of the filament or filaments on the other hand, may vary between large limits. It depends upon the special conditions in which spinning takes place, such as for instance the length of the cell, the constitution of the solutions employed, the nature of the solvent or solvents, the form and the dimensions of the spun fibre or fibres, the selected temperature, the method of heating, etc. To ascertain the most favourable distance in each particular case, is not beyond the competency of an experienced technician.

Before entering the cell, or during its journey through it, the selected gaseous medium, entering opposite the spinning dies, may be

heated in any suitable manner as has been said above. It will be useless to provide also such devices between the spinning dies and the exit orifices of the evaporating gaseous medium. On the contrary, and according to what has been said above, cooling devices, established on the same principle, for instance, can be provided in the latter zone.

If the walls of the cell are thermally conducting, a thermally insulating joint may be provided between the portion of the wall of the cell next to the spinning dies and next to the exit orifices, respectively.

Thermometers in suitable number may be provided to indicate the temperature at various points in the cell. The stream of air or of the selected evaporating gaseous medium may be produced in any suitable manner, The air or gaseous medium may be sent in each cell by a blower, for instance, but preferably it will be, on the contrary, aspirated by any suitable device, connected after the cell, for example between the cell and the recovery plant of the solvent or solvents, or after the said recovery plant, if any.

Obviously this recovery of the solvents is an operation entirely independent of the spinning and may be dispensed with if economical solvents (A) are employed, or if their recovery is costly, or for any other cause. In this case, the selected gaseous medium after issuing from the cell and after passing through the aspirating device, if any, may be exhausted in the surrounding atmosphere, for example, on the roof of the shed, by means of a suitable exhaust pipe, or yet carried away by water or a liquid if, for instance, the aspirating device is a liquid (water) jet aspirator, or it may be exhausted in any other manner. If wished, scrubbing towers may be inserted in the exhaust for any desired purpose, such as to free the exhaust gases from any noxious or objectionable product before rejecting it in the atmosphere.

Whether or not the recovery of the solvent or solvents (A) is performed, the gaseous medium may be used over again if desired, that is, it may be sent again into the cell or cells after having been completely or partially freed from the solvent or solvents (A) and restored to the conditions in which it is desired to use it normally, by drying, or, on the contrary, by moistening, heating, or cooling, partial exhaust and admission of fresh medium, or generally any other operation. This re-employment may be whole or partial. being limited for example to the feeding of the cell or cells on the side of the spinning dies, or, on the contrary, on the side of the exit orifice or orifices of the threads or filaments. Of course, this re-employment cannot be applied to the exit orifices of the threads or filaments, but these orifices may be chosen of very small dimensions, or may be provided with any suitable device, so as to minimize as much as possible the corresponding re-entrance of the air.

If desired, the gaseous medium issuing from a cell may be used again, wholly or in part, for feeding the next cells, this being done, for example, next to the exit orifice or orifices of the threads or filaments only, for the purpose of systematically increasing the amount of vapours of the volatile solvents in the said cells, or for any other purpose.

Generally speaking, the recovery of the volatile solvent or solvents (A) is advantageous, whether the gaseous medium is used over again or not. It may be carried out by any desired, usual, or known process, any suitable devices, apparatus, or organs necessary or desirable for the purpose being added to the cells or systems of cells. It will be convenient in this case to be able to isolate, by any suitable means, any cell or group of cells the working of which is momentarily interrupted for any reason.

It is also desirable that the total flow of the gaseous medium through the cell be limited to the strict necessary minimum, so that the proportion in volatile solvents of the medium issuing from the cell may be as high as possible, and to this end it is necessary to adjust suitably the rate of flow through each cell.

The said regulating devices, or any others which may be employed, are advantageously used, as is customary, in connection with any controlling device, such as thermometers, manometers, flow-meters, automatic analyzing apparatus, sampling taps, etc. Baffles may also be provided for the purpose of minimizing eddies in the cell.

The appended drawing represents diagrammatically, as an example only, a single cell disposed according to this invention, and adapted for vertical downward spinning, and forming a unit of a group of similar cells, of any desired importance, combined with any system not shown of recuperation of volatile solvents, the gaseous atmosphere utilized for carrying away the vapors of these solvents being the air of the sheds, and the fluid to be spun being a solution of acetate of cellulose in a mixture of acetone and of ethyl alcohol. The figure is a section along a plane along the axis, and perpendicular to the general alignment of the cells in the group.

1 is the wall of the cell preferably cylindrical and of metal, and formed of sections 1*a* and 1*b*, suitably connected to one another by means of a thermally insulating joint 1*c*, the whole being supported by a suitable frame, not shown.

2, 2*a*, are heating jackets with the same heating area, connected to a water circulating system, the water entering by inlets 3, 3, and issuing by outlets 4, 4, said inlets and outlets being preferably in series, said jackets, inlets and outlets being externally thermally

insulated by lagging 5, 5. Thermometers 6, 6, placed at different levels, allow any variation of the temperature inside the cell to be ascertained.

7 is a spinning die, formed of several elementary spinning dies, nozzles or spinnerets 7*a*, 7*a*, said spinning die 7 being pivoted about the axial support 8, in the stuffing box 9. It receives, by the piping 10, the solution of cellulose acetate in a suitable mixture of ethyl alcohol and acetone, which it is desired to spin into filaments, said solution being supplied by means of any suitable device adapted to this end, and provided with any suitable device for filtering, applying pressure, etc. To lower or otherwise control the temperature of the spinning solution before it reaches the die, the piping 10 may be provided with a water-jacket 10′ through which water or any other suitable medium of appropriate temperature may be circulated.

11 represents a conical metal member, on the polished surface of which may slide the the spun filaments. 12 is the outlet for the thread, comprising a perforated bronze member 13, made in two portions, and placed at the apex of the cone; 14 is a door to which is secured one of the portions of the outlet 13. The dotted lines 15, 15 . . . represent isolated filaments, forming by their reunion the thread 16 which, after passing through the delivery device 17, proceeds to any suitable and desirable apparatus for bobbining, twisting, etc.; devices for impregnating, etc., may also be provided, either before or after the delivery device 17. 18 is a roll placed under the orifice 12, and rotated by any suitable means, not shown, on which the thread 16 winds itself when it is broken outside the cell, either accidentally or purposely. 19 is a small door giving access to the spinnig die 7 or to one of its parts. The air of the sheds enters the cell at the same time by the outlet 12, or also, simultaneously by openings 20 and 20′, provided in the conical member 11, and by openings 21 provided above the spinnerets in the upper portion of the cell. In the upper portion of the cell and preferably in the vicinity of the die, there is provided an inlet 27 which is connected to any suitable source of supply as a reservoir 28 containing air or any other gaseous medium of the desired composition of appropriate temperature, whereby the temperature in the environment of the die may be modified independently of the rest of the cell. The air laden with the voltaile vapours is aspirated by the tube or tubes, such as 22, opening into an annular chamber 23, so as to avoid the filaments being carried away by the gaseous stream.

The aspirated air could be led to exhaust in the outside atmosphere, on the roof of the shed, for instance; if, however, it is desired to recover the volatile solvent with which it is laden, the tube or tubes 22 are connected to a collector 26, by a joint 25 provided with an interchangeable diaphragm 24. The collector 26 is common to a certain number of cells disposed in a similar manner. This collector may be provided with any desired accessory devices, and is itself connected to an air fan or pump, and to a system of apparatus for the recovery of the volatile solvents, not shown.

What I claim and desire to secure by Letters Patent is:—

1. The process of manufacturing filaments or threads by dry spinning, which comprises causing a viscous fluid to be extruded from a spinning die directly into an evaporative atmosphere, and lowering the temperature of the fluid to be spun.

2. The process of manufacturing filaments or threads by dry spinning, which comprises causing a viscous fluid to be extruded from a spinning die into an evaporative atmosphere in a closed cell, admitting a gaseous medium into the cell in the vicinity of the spinning die, and admitting a gaseous medium of different composition into the cell at a point remote from the die.

3. The process of manufacturing filaments or threads by dry spinning, which comprises causing a viscous fluid to be extruded from a spinning die into an evaporative atmosphere in a closed cell, admitting a gaseous medium into the cell in the vicinity of the spinning die, and admitting a gaseous medium into the cell at a point remote from said die, the composition and temperature of the gas admitted in the vicinity of the die being different from the composition and temperature of the gaseous medium admitted at the point remote from the die.

4. The process of manufacturing filaments or threads by dry spinning, which comprises causing a viscous fluid to be extruded from a spinning die into an evaporative atmosphere in a closed cell individual to said spinning die, admitting a gaseous medium into the cell in the vicinity of the spinning die, and aspirating the gaseous medium laden with a volatile constituent from a region of the cell intermediate the spinning die and the point of exit of the filaments from the cell.

5. The process of manufacturing filaments or threads by dry spinning which comprises causing a viscous fluid to be extruded from a spinning die directly into an evaporative atmosphere, and simultaneously lowering the temperature of the fluid to be spun before it reaches the die and in the vicinity of the die.

6. The process of manufacturing filaments or threads by dry spinning which comprises causing a viscous fluid to be extruded from a spinning die into an evaporative atmosphere in a closed cell individual to said spinning die,

admitting a gaseous medium into the cell in the vicinity of the spinning die, and withdrawing the gaseous medium laden with a volatile constituent from a region of the cell intermediate the spinning die and the point of exit of the filament or thread from the cell.

7. An apparatus for manufacturing filaments or threads by dry spinning comprising a closed cell, a spinning die disposed in said cell, and means for simultaneously lowering the temperature of the fluid to be spun before it reaches the die and of the atmosphere in the vicinity of the die.

8. An apparatus for manufacturing filaments or threads by dry spinning comprising a closed cell, a single spinning die disposed in said cell, means for admitting a gaseous medium into the cell in the vicinity of the spinning die, and means for withdrawing a gaseous medium laden with a volatile constituent from a region of the cell intermediate the spinning die and the point of exit of the filament or thread from the cell.

9. The process of manufacturing filaments or threads by dry spinning which comprises causing a viscous fluid to be extruded from a spinning die directly into an evaporative atmosphere in a closed cell, and lowering the temperature of the fluid to be spun.

10. The process of manufacturing filaments or threads by dry spinning which comprises causing a viscous fluid to be extruded from a spinning die into an evaporative atmosphere in a closed cell individual to said spinning die, admitting a gaseous medium into the cell in the vicinity of the spinning die, and admitting a gaseous medium to the cell in the region where the filament or thread issues therefrom.

11. The process of manufacturing filaments or threads by dry spinning which comprises causing a viscous fluid to be extruded from a spinning die into an evaporative atmosphere in a closed cell, admitting a gaseous medium into the cell in the vicinity of the spinning die, and admitting a gaseous medium to the cell in the region where the filament or thread issues therefrom, the temperature of the second gas being different from that admitted in the vicinity of the die.

12. The process of manufacturing filaments or threads by dry spinning which comprises causing a viscous fluid to be extruded from a spinning die into an evaporative atmosphere in a closed cell, admitting a gaseous medium into the cell in the vicinity of the spinning die, and admitting a gaseous medium to the cell in the region where the filament or thread issues therefrom, the composition of the second gas being different from that admitted in the vicinity of the die.

13. The process of manufacturing filaments or threads by dry spinning which comprises causing a viscous fluid to be extruded from a spinning die directly into an evaporative atmosphere in a closed cell, and simultaneously lowering the temperature of the fluid to be spun before it reaches the die and in the vicinity of the die.

14. The process of manufacturing filaments or threads by dry spinning which comprises causing a viscous fluid to be extruded from a spinning die directly into an evaporative atmosphere in a closed cell, simultaneously lowering the temperature of the fluid to be spun before it reaches the die and in the vicinity of the die, and withdrawing the gaseous medium laden with a volatile constituent from the region of the cell intermediate the spinning die and the point of exit of the filament or thread from the cell.

15. The process of manufacturing filaments or threads by dry spinning which comprises causing a viscous fluid to be extruded from a spinning die in an evaporative atmosphere in a closed cell, admitting a gaseous medium into the cell in the vicinity of the die, withdrawing the gaseous medium laden with a volatile constituent from a region of the cell intermediate the spinning die and the point of exit of the filament or thread from the cell, and admitting a gaseous medium in the region of the cell where the thread issues therefrom.

16. The process of manufacturing filaments or threads by dry spinning which comprises causing a viscous fluid to be extruded from a spinning die into an evaporative atmosphere in a closed cell, admitting a gaseous medium into the cell in the vicinity of the spinning die, withdrawing the gaseous medium laden with a volatile constituent from a region of the cell intermediate the spinning die and the point of exit of the filament or thread from the cell, and admitting a gaseous medium in the region where the thread issues from the cell, said gaseous medium being of different composition from that admitted in the vicinity of the die.

17. An apparatus for manufacturing filaments or threads by dry spinning comprising a closed cell, a single spinning die disposed in said cell, means for admitting a gaseous medium in the vicinity of the die, and means to admit a gaseous medium in the region of the cell where the thread or filament issues therefrom.

18. An apparatus for manufacturing filaments or threads by dry spinning comprising a closed cell, a single spinning die disposed in said cell, means for admitting a gaseous medium into the cell in the vicinity of the spinning die, means for withdrawing the gaseous medium laden with a volatile constituent from a region of the cell intermediate the spinning die and the point of exit of the filament or thread from the cell, and means to admit a gaseous medium in the region of the cell where the thread issues therefrom.

19. An apparatus for manufacturing filaments or threads by dry spinning comprising

a closed cell, a spinning die disposed in said cell, means for simultaneously lowering the temperature of the fluid to be spun before it reaches the die and of the atmosphere in the vicinity of the die, and means to admit a gaseous medium in the region of the cell where the thread issues therefrom.

20. A method of manufacturing filaments and threads by the dry spinning process which comprises causing a viscous fluid to be extruded from a spinning die directly into an evaporative atmosphere in a closed cell individual to said die introducing a gaseous medium in the vicinity of the die, causing said medium to travel in the direction of the thread and withdrawing said medium laden with solvents at a point intermediate the die and the place where the thread leaves the cell.

21. The process of manufacturing filaments or threads by dry spinning which comprises causing a viscous fluid to be extruded from a spinning die into an evaporative atmosphere in a closed cell individual to said spinning die, admitting a cooled gaseous medium in the vicinity of the die to lower the temperature of the atmosphere in the vicinity of the die, withdrawing the gaseous medium laden with a volatile constituent from the region of the cell intermediate the die and point of exit of the thread from the cell and winding the thread after it leaves the cell.

22. The process of manufacturing filaments or threads by dry spinning which comprises causing a viscous fluid to be extruded from a spinning die into an evaporative atmosphere in a closed cell individual to said die, admitting a gaseous medium into the cell in the vicinity of the spinning die, withdrawing the gaseous medium laden with a volatile constituent from the region of the cell intermediate the die and point of exit of the thread from the cell, admitting a gaseous medium to the cell in the region where the filament or thread issues therefrom and winding the thread after it leaves the cell.

In testimony whereof, I affix my signature.

EDMOND PRINCE.