Nov. 5, 1940. H. FREUDENBERG ET AL 2,220,226

APPARATUS FOR THE MANUFACTURE OF THREADS, BANDS, FILMS, FLEXIBLE TUBES, AND THE LIKE

Filed May 4, 1938

Fig. 1

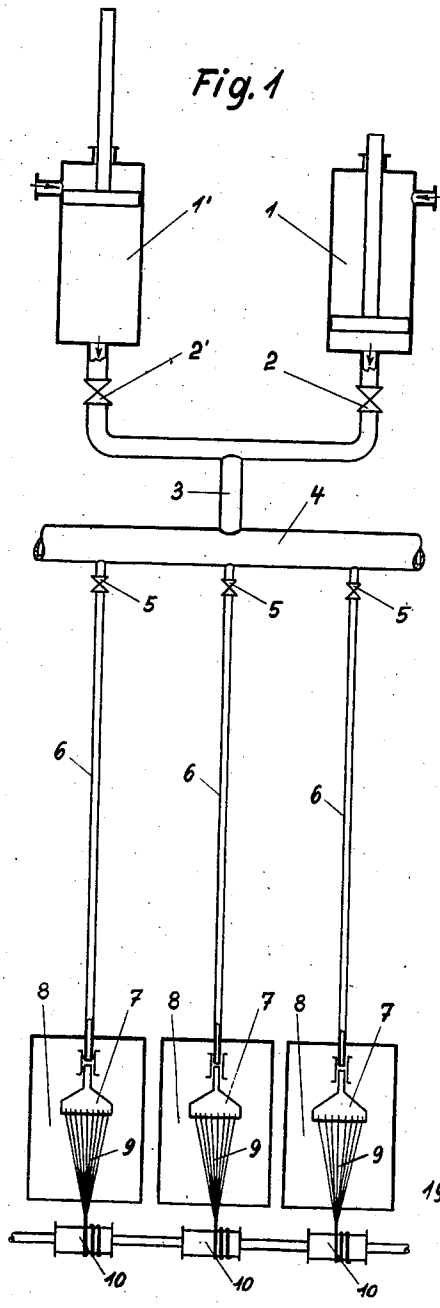
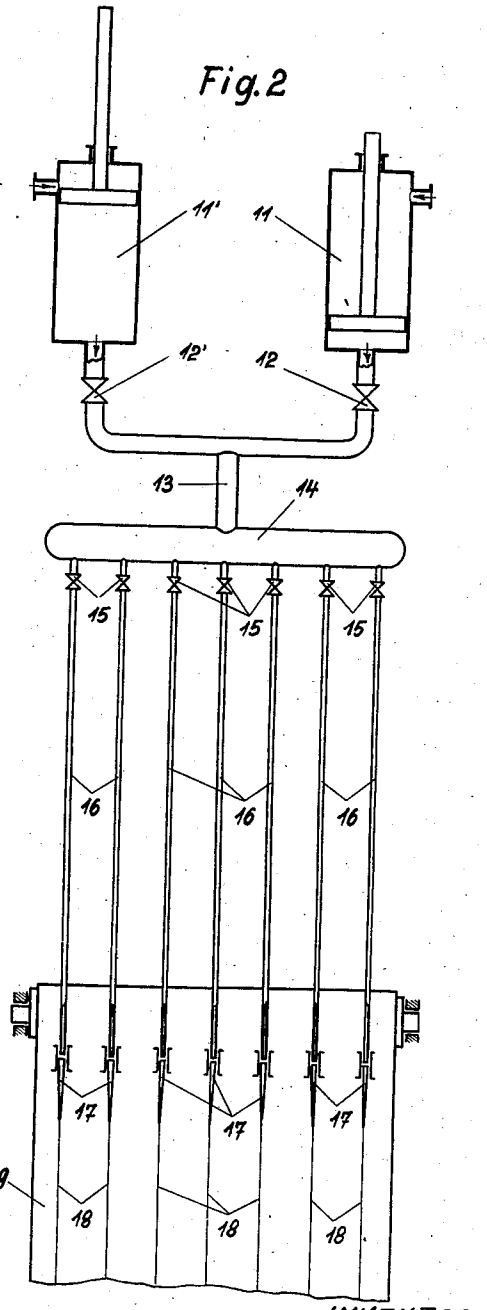


Fig. 2



INVENTORS
HANS FREUDENBERG,
OSKAR WALTER BECKER,
EMIL BRAUN,

Bailey & Parsons

ATTORNEYS

Patented Nov. 5, 1940

2,220,226

UNITED STATES PATENT OFFICE

2,220,226

APPARATUS FOR THE MANUFACTURE OF THREADS, BANDS, FILMS, FLEXIBLE TUBES, AND THE LIKE

Hans Freudenberg, Weinheim, Baden, Oskar Walter Becker, Heidelberg, and Emil Braun, Weinheim, Baden, Germany, assignors to Walter Freudenberg, Hans Freudenberg, Otto Freudenberg, and Richard Freudenberg, trading as the firm Carl Freudenberg, Weinheim, Baden, Germany

Application May 4, 1938, Serial No. 206,066
In Germany February 10, 1936

3 Claims. (Cl. 18—8)

This invention relates to an apparatus for the manufacture of threads, bands, films, flexible tubes and the like by extruding solutions or plastic masses from perforated, slot-shaped or annular nozzles. The most varied solutions, which on extrusion from nozzles yield the desired shaped products, either by the dry spinning process by evaporation of the solvent contained therein or by the wet spinning process by precipitation of the substance dissolved therein, may be used as starting materials. In particular all solutions may be employed, which have hitherto been used for the production of artificial silk, such as viscose, solutions of cellulose in cuprammonium, solutions of cellulose esters, such as cellulose acetate, cellulose formate or nitrocellulose, or cellulose ethers, such as methyl cellulose. In addition however the most varied plastic masses of amorphous or fibrous character, which are suitable for the production of shaped products, may also be used as starting materials, for example the most varied kinds of artificial resins, such as urea- or thiourea- or formaldehyde-resins, glyptal resins, polyvinyl compounds, polyacryl compounds, polystyroles and their solutions. Finally plastic fibrous masses, such as are obtained from animal fibrous starting materials, for example skin, flesh or sinews, by swelling and comminuting treatments, may be employed as starting materials either alone or in admixture with other swollen or non-swollen fibres.

In the manufacture of artificial threads, films, bands, flexible tubes and the like by extruding suitable starting materials from nozzles, the greatest importance must be attached to uniform rate of discharge of the shaped products. As a result of this uniform rate of discharge the individual shaped products are obtained under constant conditions of tension and are uniform along their entire length. Still more important is the simultaneous and uniform rate of discharge of the mass or solution to be shaped from the shaping device when employing a plurality of nozzles, particularly if the shaped products discharging from these nozzles have to be deposited on a common moving base or have to be wound on to a common device.

The constant rate of discharge of solutions or masses to be shaped has hitherto been achieved by disposing in front of each individual nozzle a device, which ensures uniform outflow of the spinning solution. Small cogwheel pumps are generally employed, which all rotate at the same and uniform speed and always force the same quantity of spinning solution per unit of time through the nozzles. Known processes for maintaining the spinning pressure uniform for all nozzles were less successful. The unavoidable impurities in the spinning solutions and the changes in viscosity caused by alterations in temperature cause these processes to operate unsatisfactorily. Consequently they scarcely found their way into the industry.

The apparatus of this invention enables a plurality of shaped products to be simultaneously produced, which all discharge from the nozzles at the same and uniform rate. It consists of a pressing device, of a distributing device connected with the pressing device, of at least two shaping nozzles and at least two tubes, each of which is inserted between the distributing device and one shaping nozzle and has at least the same cross-section as the shaping nozzle and is of such a length that the resistance in this tube is considerably greater than in the shaping nozzles. Particularly good results are obtained if the resistance in the inserted tubes is at least twice as great, preferably 4–6 times as great, as in the shaping nozzle. This resistance is determined by the fall in pressure in the parts traversed by the spinning solution or spinning mass. The fall in pressure in the inserted tubes must accordingly be at least twice, preferably 4–6 times, as great as in the shaping nozzles. The cross-section of the inserted tubes is preferably 2 to 3 times as great as the cross-section of the shaping nozzles. The cross-section of the inserted tubes must in no circumstances be smaller than the cross-section of the nozzles.

The invention offers the considerable advantage that it enables a plurality of shaping nozzles to be connected with one common pressing device, which maintains the spinning mass under constant pressure. With a given viscosity the rate of outflow is then dependent only on the resistances in the shaping nozzles. If therefore all the nozzles were of the same dimensions, it would be theoretically expected that the shaped products would discharge at the same rate from all the nozzles, even without the insertion of the tubes to be employed according to this invention. In practice however the viscosities at any moment are never the same, since impurities are always present. Moreover the dimensions of the nozzles are never absolutely the same. Consequently in practice it is impossible, on feeding a plurality of nozzles from the same pressing device, to obtain shaped products, which discharge at the same rate from the nozzles. If however such shaped products, for example threads, dis-

charge at different rates from the nozzles and are thereafter deposited on to a base, for example an endless belt which moves at constant speed, the threads are subjected to varying tension in accordance with their rate of discharge. Threads are obtained thereby, which show very considerable deviations both in their diameter and also in their strength.

It is a different matter if tubes, in which the fall in pressure is considerably greater than in the shaping nozzles, are inserted according to this invention between the pressing device and the shaping nozzles. In the normal operation of such a spinning device only a fraction of the total working pressure of the pressing device is exerted at the nozzle inlet, because by far the greater part of this total pressure is used up by the resistance of the inserted tubes. Accordingly the rate of spinning is chiefly determined by the inserted tube. If any impurity finds its way into the mass or solution extruded through a nozzle or if the viscosity of this solution or mass has altered, this nozzle will operate more slowly and less uniformly and will require a higher pressure than the other nozzles, to enable all the nozzles to operate at the same speed. In this case the inserted tube automatically commences to function. The slowed down discharge of the spinning solution or spinning mass from a nozzle at the same time indicates a retarded rate of flow in the tube inserted in front thereof. A slower movement of the mass takes place therein and accordingly also there is less friction between the individual particles of the mass itself and at the walls of the tube and also a lower fall in pressure. With constant total pressure the desired relatively high pressure must thereby be exerted in the shaping nozzle. If one nozzle becomes completely blocked, the total pressure of the pressing device is exerted at the obstructed position owing to the inserted tube. The arrangement accordingly acts as if, at the moment that the nozzle becomes obstructed, the pressing device automatically operates at higher pressure and thereby removes the obstruction. In actual fact owing to the pre-inserted tube this higher pressure is exerted in the obstructed nozzle itself to the extent necessary to remove the obstruction.

In order to prevent any impurities or non-uniformity in viscosity from exerting a detrimental effect in the inserted tubes it is advisable that the cross-section of the tubes should not be too small. It has been found that tubes having a cross-section 2 to 3 times as great as that of the shaping nozzles are entirely satisfactory. The length of the tubes depends on their cross-section and the desired fall in pressure.

This invention not only enables a plurality of nozzles to be supplied from the same pressing device, but also enables the shaped products discharging from the individual nozzles to be deposited on the same conveying or collecting device, for example a conveyor belt or a winding device, travelling at the same speed.

In this way there are obtained in an entirely continuous process shaped products, which are of great uniformity with regard both to thickness and strength.

This invention at the same time enables the process of manufacturing shaped products from solutions or plastic masses to be considerably more simply and cheaply carried out than all the known processes, since instead of costly spinning pumps simple tubes are employed.

This invention is not limited to any particular pressing device nor to any particular construction of the spinning nozzles. The most varied pressing devices and also the most varied spinning nozzles may be employed, particularly nozzles with only one hole or sprinkler-like nozzles with a plurality of holes or slot-shaped or annular nozzles. The cross-section of the inserted tubes may vary in shape. The use of cylindrical tubes is most advantageous. The invention is moreover not limited to any particular spinning solution or spinning mass, but may be employed for the most varied known spinning solutions and plastic masses. It may be particularly successfully employed for viscous solutions or plastic masses having a fibrous structure. Such fibrous masses are obtained from animal fibrous starting materials such as hide, sinews, flesh, muscular tissue, or de-tanned leather by chemical, biological or thermal decomposition, if necessary supplemented by mechanical treatments. The chemical decomposition is preferably effected by treating the fibrous starting materials with swelling chemicals and by mechanical comminution and shredding in such a way that the fibrous structure is preserved as far as possible, for example according to the processes of Patents Numbers 2,056,595, 2,056,596; or 2,120,851. Fibrous masses as aforesaid consist of swollen fibres or fibre bundles embedded in a gelatinous mass. On extruding such masses from nozzles obstructions can of course occur particularly easily. For masses, which are not homogeneous, the usual cogwheel pumps employed in the artificial silk industry are unserviceable, owing to the considerable pressure to be overcome. It has hitherto only been possible to work up such fibrous masses by extrusion from a plurality of nozzles and depositing or collecting the resulting shaped products on bases or winding devices moving at the same speed, by employing the process of this invention.

The invention is illustrated by way of example in the accompanying diagrammatic drawing, wherein—

Fig. 1 illustrates the application of the invention to the production of threads from artificial silk solutions by the wet spinning process, and

Fig. 2 illustrates the application of the invention to the production of threads from fibrous masses of animal origin by the dry spinning process.

The two compression cylinders 1 and 1' in Fig. 1 are alternately filled with the artificial silk spinning solution, which is pressed through the valves 2 and 2' into the tube 3 and the distributing member 4. The spinning solution passes from the latter through the valves 5 into the tubes 6, which are 1 mm. in diameter and 500 mms. long. The spinning solution passes from the tubes 6 into the perforated sprinkler-like nozzles 7, the spinning holes of which are from 0.05 to 0.2 mm. in diameter and from there passes at the same and uniform rate into the precipitating baths 8. The threads 9 formed on coagulation are collected and wound on the winding devices 10.

Referring to Fig. 2 of the drawing, the compression cylinders 11 and 11' are alternately filled with a plastic kneadable highly swollen fibrous mass, which has been produced from hide by swelling and comminution. This mass is pressed from the compression cylinders through the valves 12 and 12' into the tube 13 and the distributing member 14, from which they pass in

controlled flow through the valves 15 into the cylindrical tubes 16. These tubes are 1000 mms. long and 2 mms. in diameter. The mass passes from the tubes 16 into conical one-hole nozzles 17, the diameter of which at their outlet end is 0.5 mm. The threads 18 discharging from the nozzles at the same and uniform speed are deposited on the moving conveyor belt 19.

What we claim is:

1. An apparatus for the manufacture of shaped products such as threads, bands, films and flexible tubes from solutions or plastic masses comprising a pressing means, a distributing means connected with such pressing means, at least two shaping nozzles and at least two tubes each of which is inserted between the distributing means and one of said shaping nozzles and connected immediately with such shaping nozzle, each tube being at least of the same cross section as the outlet area of the shaping nozzle connected therewith and being of sufficient length that the fall in pressure therein is at least twice as great as in the shaping nozzle.

2. An apparatus for the manufacture of shaped products such as threads, bands, films and flexible tubes from solutions or plastic masses comprising a pressing means, a distributing means connected with such pressing means, at least two shaping nozzles and at least two tubes, each of which is inserted between the distributing means and one of said shaping nozzles and connected immediately with such shaping nozzle, each tube being at least of the same cross section as the outlet area of the shaping nozzle connected therewith and being of sufficient length that the fall in pressure therein is at least four times as great as in the shaping nozzle.

3. An apparatus for the manufacture of shaped products such as threads, bands, films and flexible tubes from solutions or plastic masses comprising a pressing means, a distributing means connected with such pressing means, at least two shaping nozzles and at least two tubes, each of which is inserted between the distributing means and one of said shaping nozzles and connected immediately with such shaping nozzle, the cross section of each tube being at least twice that of the outlet area of the shaping nozzle connected therewith and being of sufficient length that the fall in pressure therein is at least four times as great as in the shaping nozzle.

HANS FREUDENBERG.
OSKAR WALTER BECKER.
EMIL BRAUN.