United States Patent [19]

Stockbridge

[11] **3,881,850**

[45] **May 6, 1975**

[54] **MELT SPINNING TOWER MODULE AND CIRCULAR MELT SPIN BLOCK THEREFOR**

[75] Inventor: **Bruce W. Stockbridge,** Kingsport, Tenn.

[73] Assignee: **Eastman Kodak Company,** Rochester, N.Y.

[22] Filed: **Jan. 2, 1974**

[21] Appl. No.: **430,121**

[52] **U.S. Cl.** **425/72;** 425/382.2

[51] **Int. Cl.** **D01d 5/08**

[58] **Field of Search** ..... 425/72, 198, 382.2; 264/176 F

[56] **References Cited**

UNITED STATES PATENTS

1,955,825	4/1934	Palmer	264/176 F X
2,541,305	2/1951	Taylor	425/72
3,824,050	7/1974	Balk	425/382.2 X

FOREIGN PATENTS OR APPLICATIONS

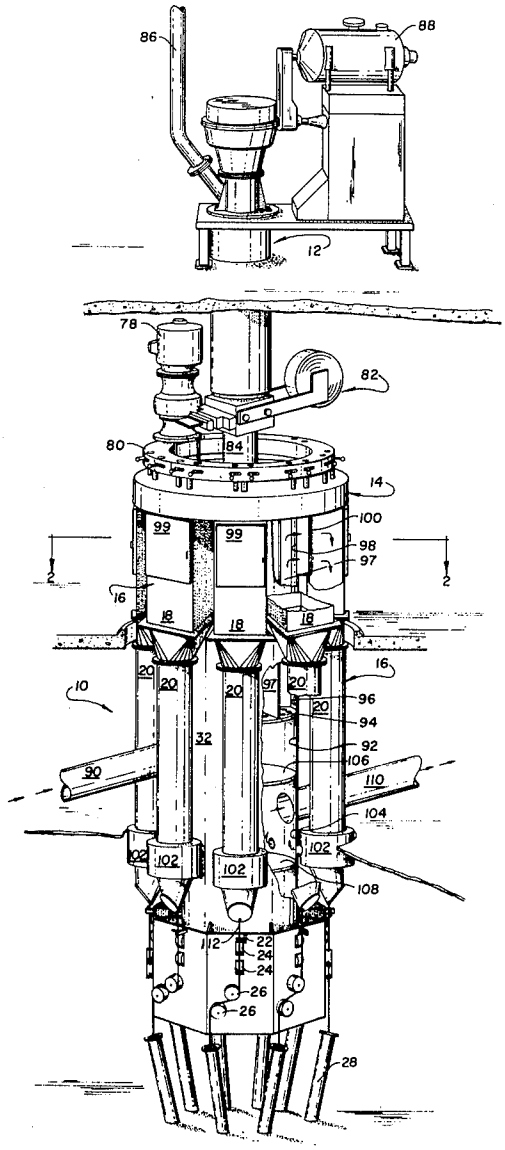
32,966	10/1973	Japan	425/72
760,329	10/1956	United Kingdom	425/382.2

Primary Examiner—Robert D. Baldwin

[57] **ABSTRACT**

A circular melt spinning tower module for melt spinning of polymers into textile filaments, the module having attached to and depending from and around the module multiple quench cabinet-take-up assemblies; and a circular melt spin block capping the tower module and having a plurality of spin packs located at equal radial distances from the center of the spin block and spaced at equal interval distances around the block.

7 Claims, 4 Drawing Figures



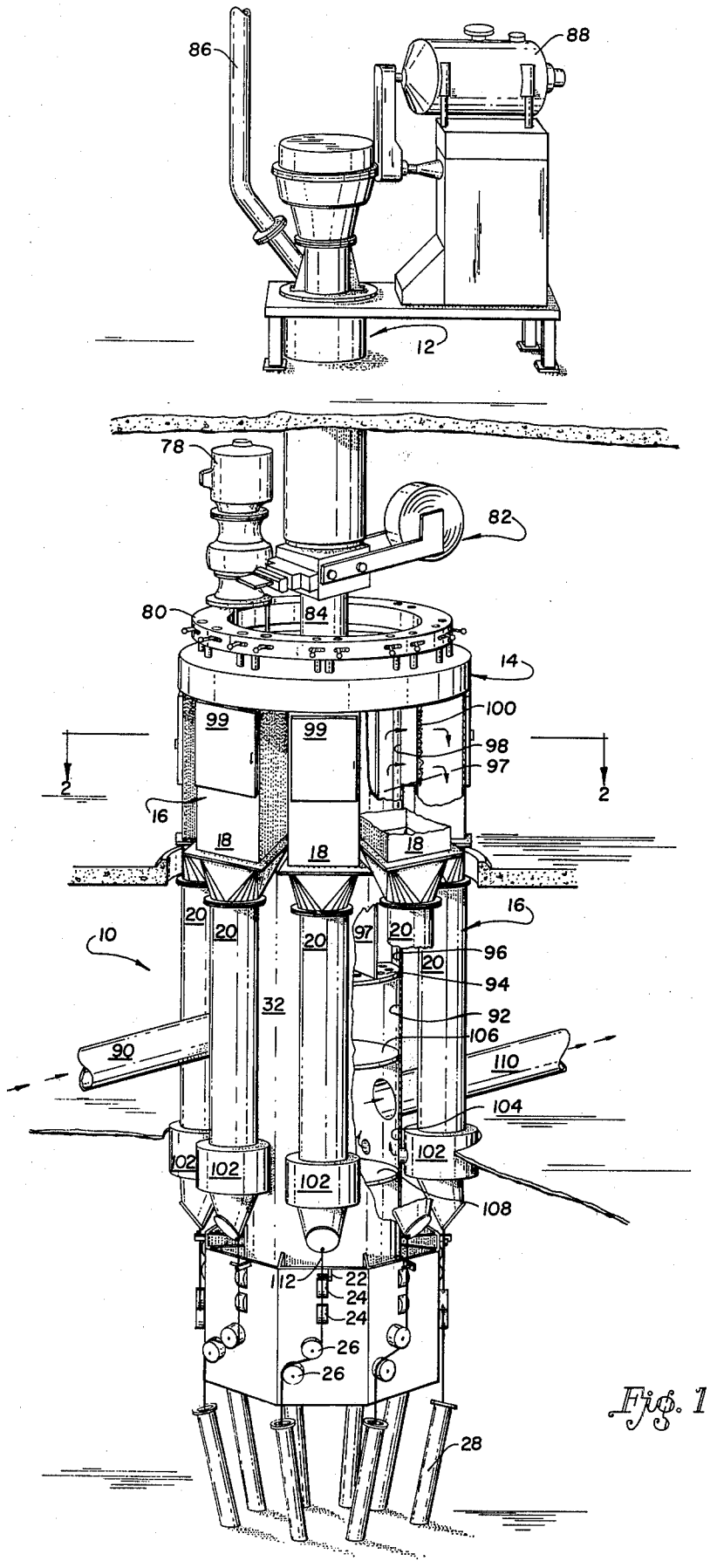

86
88
12
78
82
80
84
14
100
99
99
98
97
2
2
16
18
18
18
20
20
20
97
20
16
10
96
20
94
32
92
106
90
110
104
102
102
102
102
108
112
22
24
24
26
26
28

Fig. 1

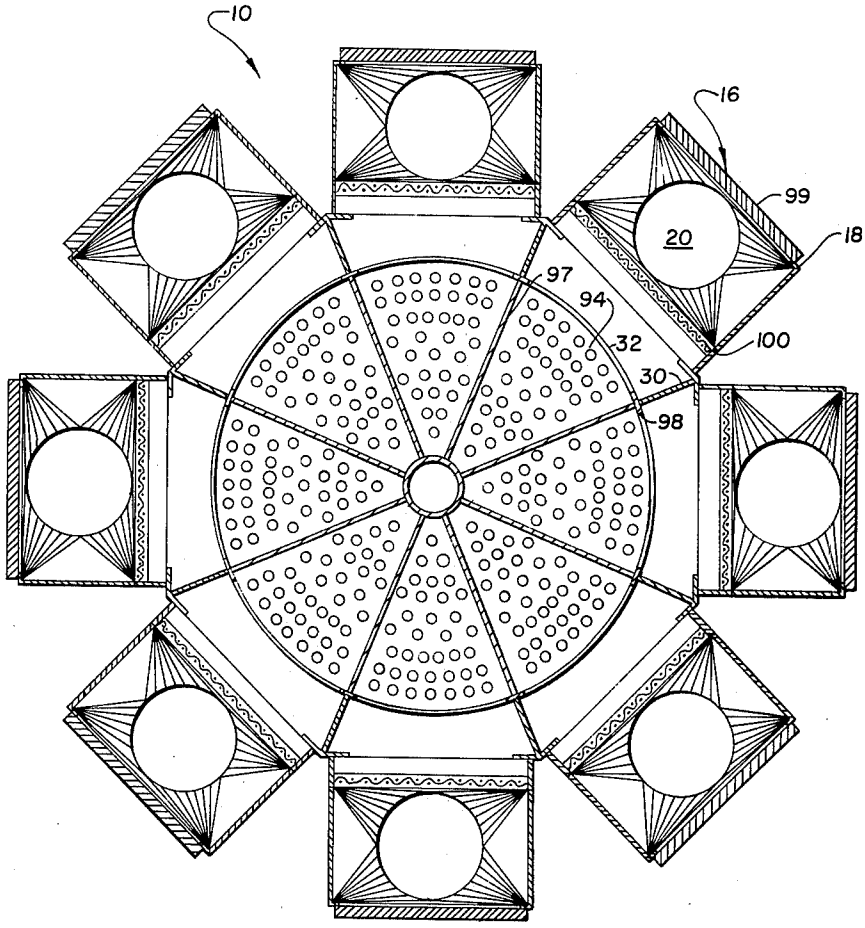

10
16
99
18
20
97
94
32
100
30
98

Fig. 2

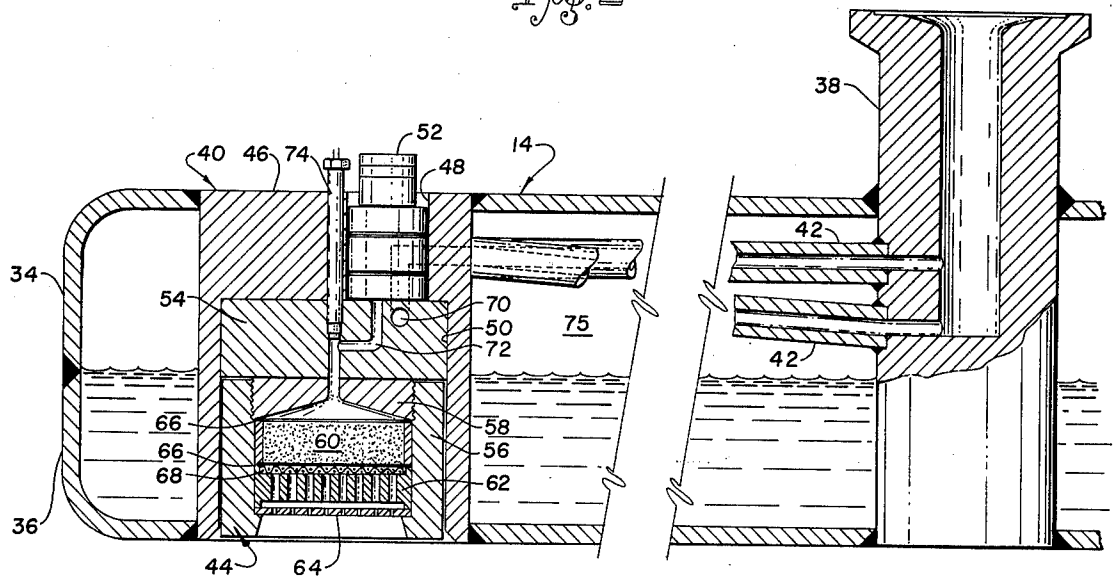

38
42
42
52
40
46
74
48
14
34
54
70
50
72
75
66
66
68
60
58
56
62
36
44
64

Fig. 3

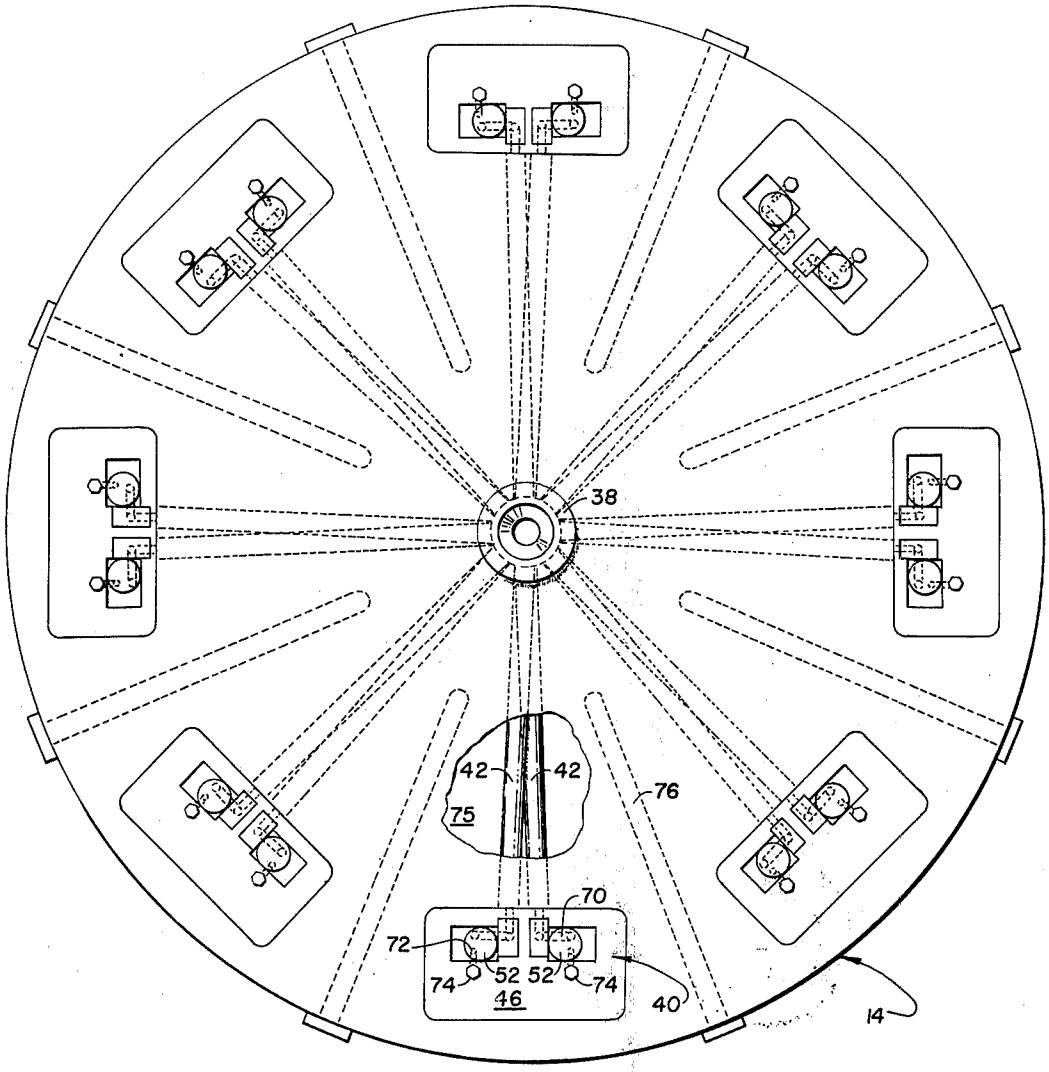


Fig. 4

MELT SPINNING TOWER MODULE AND CIRCULAR MELT SPIN BLOCK THEREFOR

BACKGROUND OF THE INVENTION

The present invention is directed to a melt spinning tower module of multiple, vertically depending quench cabinet-take-up assemblies around the module, and to a circular melt spin block for the tower module and having within the spin block conduits of minimal and equal lengths radiating from a centrally located polymer inlet of the spin block to spin packs leading to the quench cabinet-take-up assemblies for melt spinning of polymers into textile fibers and the like.

The apparatus conventionally employed in the melt spinning of synthetic or man-made fibers includes a melt extruder; a spin block or spin beam connected to the melt extruder and heated by a heat transfer fluid or vapor; conduits within the spin block or spin beam for conveying polymer from the melt extruder to a number of metering pumps mounted on the spin block; and spinneret assemblies mounted within cavities in the spin block to which the polymer is pumped from and by the metering pumps. The Lehner U.S. Pat. No. 3,562,858 and the Lenk et al, U.S. Pat. No. 3,655,314 disclose examples of spinning beams.

The conventional apparatus is usually arranged so that there is a long single row of spinning positions, or is arranged in a rectangular configuration with two parallel rows of spinning positions with spinnerets in back-to-back positions. In such arrangements, the polymer distribution conduits within the spin block or spin beam must take a serpentine path in order to assure that there will be essentially the same polymer residence time to and at all spinning positions. The same polymer residence time at all spinning positions is essential because if the thermal pretreatment of the melt spun filaments at one or more positions should be different from that at the remaining positions, there will be a significant difference in the properties of the spun filaments. It is usually the practice, therefore, to employ conduits of equal length to each spinning position for the conveying or flow of the polymer to the spinnerets.

One disclosed approach for assuring that the properties of the melt spun filaments are the same for each of a plurality of spinning machines is shown in German Pat. No. 2,220,221 (Offenlegungsschrift) filed in Germany, Apr. 25, 1972, (published Nov. 16, 1972). The patentees wish to assure the same thermal pretreatment of the filaments in each spinning machine. The polymer, therefore, is caused to be led from the final stage of a polycondensation reactor through a vertical pipe to a circular manifold or distributor. The circular manifold or distributor distributes to a plurality of feed pipes that are of equal length and radiate out from the distributor with each feed pipe leading to a separate "spinning machine." The polymer, upon entering the spinning machine, is conveyed through what appears from the drawing to be a long block to a metering pump for subsequent extrusion as filaments from one or two spinnerets or "spinning nozzles." The filaments leave the spinning nozzles, pass through an air space and then enter into a liquid cooling bath. The filaments exit from the bath and pass over a stationary guide pin; are then drafted by drafting rolls; crimped by a stuffing box crimper and finally wound onto a yarn bobbin. The spinning machines extend horizontally outwardly in long lines like so many spokes on a wheel with the circular manifold or distributor serving as the hub of the wheel.

The polymers referred to herein may be any synthetic organic thermoplastic polymer suitable for melt spinning, as known in the art, and include, for example, polymides; polyesters; polyhydrocarbons, such as polyethylene and polypropylene; polyurethanes; polyureas; vinyl polymers, such as polyvinyl chloride, polyvinyl chloride and copolymers thereof; acrylic polymers and copolymers thereof, and many others that might be mentioned but which are well-known in the art.

In reference again to conventional apparatus, as the melt spun filaments exit from the spinnerets they are quenched and cured by air flowing through screens in quench cabinets, the air passing down through quench stacks along with the filaments, with the filaments exiting from the quench stacks to pass over lubrication or finish rolls and godet rolls to subsequent processing operations.

Mechanics and millwrights are usually required to install in a plant on a piece-by-piece basis the spin blocks or spin beams, extruders, quench cabinets, quench stacks, air ducts for the quench cabinets, lubrication or finish rolls and godet rolls. The time it takes for such installation is long and the resulting costs are high. The cabinets alone and the structure on which the lubrication rolls and godet rolls are mounted occupy a space about 18 feet in length by about 12 to 14 inches in depth for a series of eight such cabinets in a row. If the cabinets are in double rows or back-to-back for a total of 16 such cabinets, then the overall depth may be about 5 feet in order to allow space between the two rows for necessary equipment generally associated with such cabinets.

SUMMARY OF THE INVENTION

The invention comprises a melt spinning tower module of multiple quench cabinet-take-up assemblies depending vertically around the module and a circular melt spin block, which caps the tower module and has within the spin block conduits of minimal and equal lengths, each conduit radiating from a centrally located polymer inlet of the block to a spin pack assembly leading to one of the vertically depending quench cabinet-take-up assemblies for melt spinning of polymers into textile fibers and the like.

The circular melt spin block has a centrally located polymer inlet at the top of the block for receiving therethrough melted polymer from a supply source such as a vertical extruder or final stage of a polycondensation reactor. The spin block has a plurality of melt spin pack assemblies located in cavities in the block at equal radial distances from the polymer inlet and spaced at equal intervals around the spin block. Each spin pack assembly serves one of the vertically depending quench cabinet-take-up assemblies on the tower module and may have one or two spinnerets per assembly. The conduits each extend in fluid communication with and from the polymer inlet in a direct path to one of the spin pack assemblies by way of one or two metering pumps located at each spin pack assembly. In this manner of construction the polymer residence times are not only equal but can be held to lower values than with conventional arrangements. The spin block further has a chamber that extends around the polymer inlet, the conduits and a large portion of each of the spin pack assemblies. The chamber has a heated me-

dium, such as a heating oil or liquid-vapor, which maintains the melted polymer at a predetermined temperature. In the overall manner of construction of the circular spin block, therefore, a uniform temperature is achieved for the filaments extruded at all positions around the spin block, and thus would also be achieved for the spin block of each individual or separate melt spinning tower module in a series of such modules in a textile filament producing plant.

The quench cabinet-take-up assemblies depend vertically downwardly of the tower module around the module like so many segments of a pie. Each quench cabinet-take-up assembly includes a quench cabinet, which is located directly below a spin pack assembly in the circular melt spin block and which is in open communication with the spinneret or spinnerets of the spin pack assembly. As the melt spun filaments are extruded from the spinneret(s) they are quenched by a gaseous or quenching medium, such as air, that is diffused through screens in the cabinet walls; and the filaments are cured as they pass down through a quench stack following the quench cabinet. As the filaments emerge from the quench stack into the open air they are processed by passing over lubrication or finish rolls, which apply a lubricant or finish to the filaments to aid in later processing of the filaments. The filaments then pass over godet rolls to still further processing operations.

The tower module has a central column or hollow upstanding pipe which forms the central supporting core within which may be located the supporting utilities for the quench cabinet-take-up assemblies, such as the quenching medium or air supply and exhaust conduits, electrical conduits, electric motors and controls, roll drives, doffing waste storage compartment, yarn lubricant system; quench air supply chambers and return chamber. The entire tower module can be constructed and assembled in the machine shop, transported to the plant location and lifted into operating position by crane. Alternatively, the central core can be prepared and suitably fitted in the machine shop and then transported and lifted into position, followed by subsequent attachment of the quench cabinet-take-up assemblies and capping by the circular melt spin block. The outside cylindrical wall of the hollow pipe forms the back wall of each of the quench cabinets, with radial dividers connected to the hollow pipe and forming the side walls of the cabinets.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is an isometric view of the melt spinning tower module and depending quench cabinet-take-up assemblies with portions cut away to illustrate a quench stack screen, and some of the different chambers that may be formed within the tower module;

FIG. 2 is a top view of the tower module taken along line 2—2 of FIG. 1;

FIG. 3 is an enlarged view in elevation of a portion of the circular spin block and illustrating the cavities in the spin block and the spin packs; and

FIG. 4 is an enlarged plan view of the circular melt spin block.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In reference to the drawings, the melt spinning tower module **10** may be supplied with melted polymer from the vertical extruder **12** positioned above the module or by the last stage of a polycondensation reactor (not shown). The vertical extruder is incidental to the invention and is well-known in the art; therefore, no further description will be given of its components or its operations.

The tower module is capped, so-to-speak, by the circular melt spin block **14**; and depending vertically from the spin block and attached to and around the tower module is a plurality of quench cabinet-take-up assemblies **16.**

Each quench cabinet-take-up assembly includes a quench cabinet **18,** followed by a quench stack **20** below the quench cabinet, yarn guide **22,** lubrication or finish rolls **24** and godet rolls **26.**

A quench cabinet-take-up assembly may, if desired, include other yarn or fiber processing apparatus, such as a crimper, or a texturizing apparatus, or a bobbin winder, or combinations of any of these, or may, as illustrated in FIG. **1,** puddle directly into a can (not shown) by means of the transport and guide tubes **28** below the tower module for subsequent later withdrawal and processing.

In reference to FIG. **2,** the quench cabinet-take-up assemblies **16** are shown extending around and spaced outwardly from the tower module and separated from other such assemblies by radial dividers **30.** The hollow upstanding pipe, which is also the main support of the tower module, is shown at **32.**

In reference to FIGS. **3** and **4,** which illustrate in greater detail the circular melt spin block **14,** the spin block may be readily constructed from a pair of flanged heads **34, 36** (FIG. **3**) suitably fastened together as by welding, with openings formed in the flanged heads to receive the centrally positioned polymer inlet tube **38,** which also forms a manifold, and the spin pack assemblies **40.** The polymer inlet tube and the respective spin pack assemblies are connected together for flow of melted polymer therebetween by a plurality of conduits **42.**

Each spin pack assembly **40** may include one or two spin packs **44.** If the spin pack should involve an obround spinneret, the spin pack assembly will probably include only one such spin pack. If, on the other hand, the spin pack involves a circular spinneret, it may be considered preferable, then, that the spin pack assembly include two spin packs. In this latter instance, therefore, there would be two conduits **42** leading from the polymer inlet tube to the spin pack assembly, one for each spin pack, as shown in FIG. **3.** The Stockbridge patent, U.S. Pat. No. 3,299,470, discloses both a circular and an obround spinneret construction.

The spin pack assembly **40** illustrated in the drawings comprises a pump and mounting block **46** within which are formed cavities **48** and **50** for receipt, respectively, of a pair of metering pumps **52** and a pair of spin packs **44.** Within the lower cavity **50** are mounted a pump mounting flat **54,** pack body **56,** clamping plate **58,** filter media **60,** support plate **62,** spinneret plate **64,** gaskets **66,** and screen **68.**

The pump mounting flat has formed therein a pump inlet conduit **70** leading from conduit **42** into a metering pump **52,** and a pump outlet conduit **72** leading from the metering pump into the spin pack **44.** A pressure probe is shown at **74** for measuring amount of pressure of the melt polymer flow.

The circular spin block **14** is otherwise hollow and defines a chamber **75** for receipt therewithin and around the spin pack assemblies **40**, the conduits **42** and the polymer inlet tube **38** a suitable heating oil for liquid-vapor heating of the spin block for purposes for maintaining the melted polymer at a predetermined temperature. The heating oil is preferably sealed within the spin block and is maintained at a predetermined temperature by a plurality of electric heaters **76**, as shown in FIG. **4**.

The drive motor for all of the metering pumps **52** is shown at **78** in FIG. **1**, and a metering clutch mechanism **80** is provided to connect any or disconnect any of the metering pumps. An automatic screen filter is shown at **82**, and a static mixer may suitably be disposed at **84**.

OPERATION

In operation of the overall apparatus disclosed in FIG. **1**, the polymer may enter initially in pellet form through the polymer pellet feed conduit **86** into the vertical extruder **12**. The extruder is driven by the extruder drive shown at **88**. The extruder melts the polymer, which may subsequently be blended, if desired, by the static mixer **84** prior to passing through the polymer inlet tube **38** into the circular spin block **14** for distribution to the spin packs **44**. The polymer extrudes from the spinneret plates **64** in the form of multiple hot, thin plastic filaments into the quench cabinet **18** of the quench cabinet-take-up assembly **16**.

The quenching of the hot, thin plastic filaments may be accomplished by a gas such as air that is supplied to the tower module **10** through a supply duct **90**. The air, usually at ambient temperature, enters the duct and passes into quench air supply chamber **92** for subsequent diffusion through a perforated plate **94** into a second chamber **96** above the perforated plate. The upper end of the upstanding pipe **32** also forms the back wall of the quench cabinets **18**. A plurality of openings **98**, one for each cabinet, is formed through the back wall so that the diffused air may pass from the second chamber **96** through honeycomb screens **100**, one being located at the back of each quench cabinet, for flow against the hot plastic streams.

The second chamber **96** above the perforated plate is, preferably, further divided by radial dividers **97** into a number of smaller chambers, one for each quench cabinet. In this manner of construction, when the door **99** to one of the quench cabinets **18** is opened, the airflow to the other quench cabinets will not be affected. Additional means (not shown) may be provided within these smaller chambers **75** for the purpose of trimming the airflow from one quench cabinet to another. Such additional means may be an auxiliary perforated plate which may be moved relative to the main perforated plate **94** for partially or completely closing the perforations in the perforated plate **94**.

The plastic filaments are quenched and are cured as they pass downwardly through the respective quench stacks **20**. Most of the air is exhausted from the quench stack through exhaust manifold **102** into a quench air return chamber **104**, which is defined between separator plates **106**, **108**. The air passes from this latter chamber out of the tower module through an exhaust duct **110**.

The cured yarn filaments **112** emerge from the quench stack, pass over the yarn guide **22**, and then pass over the lubrication or finish rolls **24** and the godet rolls **26**. The godet rolls serve to pull the filaments from the quench stacks. The yarn filaments from each quench cabinet-take-up assembly **16** may then be fed into the illustrated respective transport and guide tubes for puddling into storage containers (not shown) on the floor below the tower module or may be joined to form a tow for subsequent processing.

As previously indicated, the tower module may contain a waste yarn storage bin and the electric motors and controls for the drives for the godet, lubrication or finish rolls, and the like. The operator may readily thread the yarn filaments into the transport and guide tubes by an aspirator gun.

The melt spinning tower module **10** promotes better house cleaning efficiencies than the conventional spinning machines because of the fact that most of everything is contained within the tower module with the floor space beneath the module easily kept clean and free of debris.

Each melt spinning tower module **10** with its multiple quench cabinet take-up assemblies **16** occupies a smaller space lengthwise than conventional spinning machines so that more tower modules can be fitted within a given space.

Since the more difficult and time consuming assembly of wiring, and the like, can be accomplished in the machine shop as the tower module is being fabricated, the erection of the tower module and its quench cabinet-take-up assemblies at the operating site can be accomplished in less time.

The invention has been described in detail with particular reference to certain preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

I claim:

1. A melt spinning tower module for melt spinning of polymers into textile filaments, the tower module comprising:

an upstanding central core;

a circular spin block positioned at the top of the central core, and having inlet means for receiving melted polymer within the spin block from a source of supply and having a plurality of spin packs through which the melted polymer is spun from the spin block into a plurality of hot, plastic filaments; and

a plurality of quench cabinet-take-up assemblies connected to, extending around and down the outside of the central core for receiving from respective spinning packs in each assembly the hot, plastic filaments;

each quench cabinet-take-up assembly including a vertically extending quench cabinet within which the hot, plastic filaments are quenched; a vertically extending quench stack below and following the quench cabinet for continued quenching and curing the hot, plastic filaments into textile filaments; and means below the quench stack for processing the textile filaments as they emerge from the quench stack;

said upstanding central core being cylindrical and hollow, and its cylindrical wall forming a back wall for each of the respective quench cabinets; each said back wall defining therethrough an opening; and means for introducing through each of the

openings into the quench cabinets a quenching medium directed against the hot, plastic filaments being spun into the quench cabinets.

2. A melt spinning tower module as defined in claim 1, a plurality of radial dividers extending from and around the central core and defining the side walls of the respective quench cabinets.

3. A melt spinning tower module as defined in claim 1, said means for introducing a quenching medium including an inlet into the central core for supplying thereto from a source of supply said quenching medium; first and second chambers for receiving from said inlet said quenching medium, a perforated plate separating said first and second chambers, the quenching medium being diffused by and as it passes through the perforated plate from the first chamber to the second chamber for subsequent passing out of the second chamber through each of said openings into the respective quench cabinets.

4. A melt spinning tower module as defined in claim 3, said central core including a third chamber; an inlet connected from each of the quench stacks to the third chamber through which inlets the quenching medium is exhausted from the quench stacks into the third chamber; and an outlet connected to the third chamber through which the exhausted quenching medium is exhausted from the third chamber.

5. A melt spinning tower module as defined in claim 3, said second chamber being divided into a plurality of smaller chambers, one for each quench cabinet; each smaller chamber serving to isolate the quenching medium flow to the respective quench cabinet from the flow going to the other cabinets.

6. A melt spinning tower module as defined in claim 1 and wherein said circular spin block is horizontally positioned with respect to the upstanding central core and the plurality of spin packs are located at equal radial distances from the center of the spin block and spaced at equal interval distances around the block, said inlet means being centrally located at the top of the block; said module further including a plurality of conduits connected to the inlet means and to the respective spin packs for conducting the melted polymer directly from the inlet means to the spin packs.

7. A melt spinning tower module as defined in claim 6, said circular spin block further defining a chamber around the inlet means, the conduits and the spin packs for receiving a heated medium for maintaining the melted polymer received in the spin block at a predetermined temperature.

* * * * *