

April 30, 1957

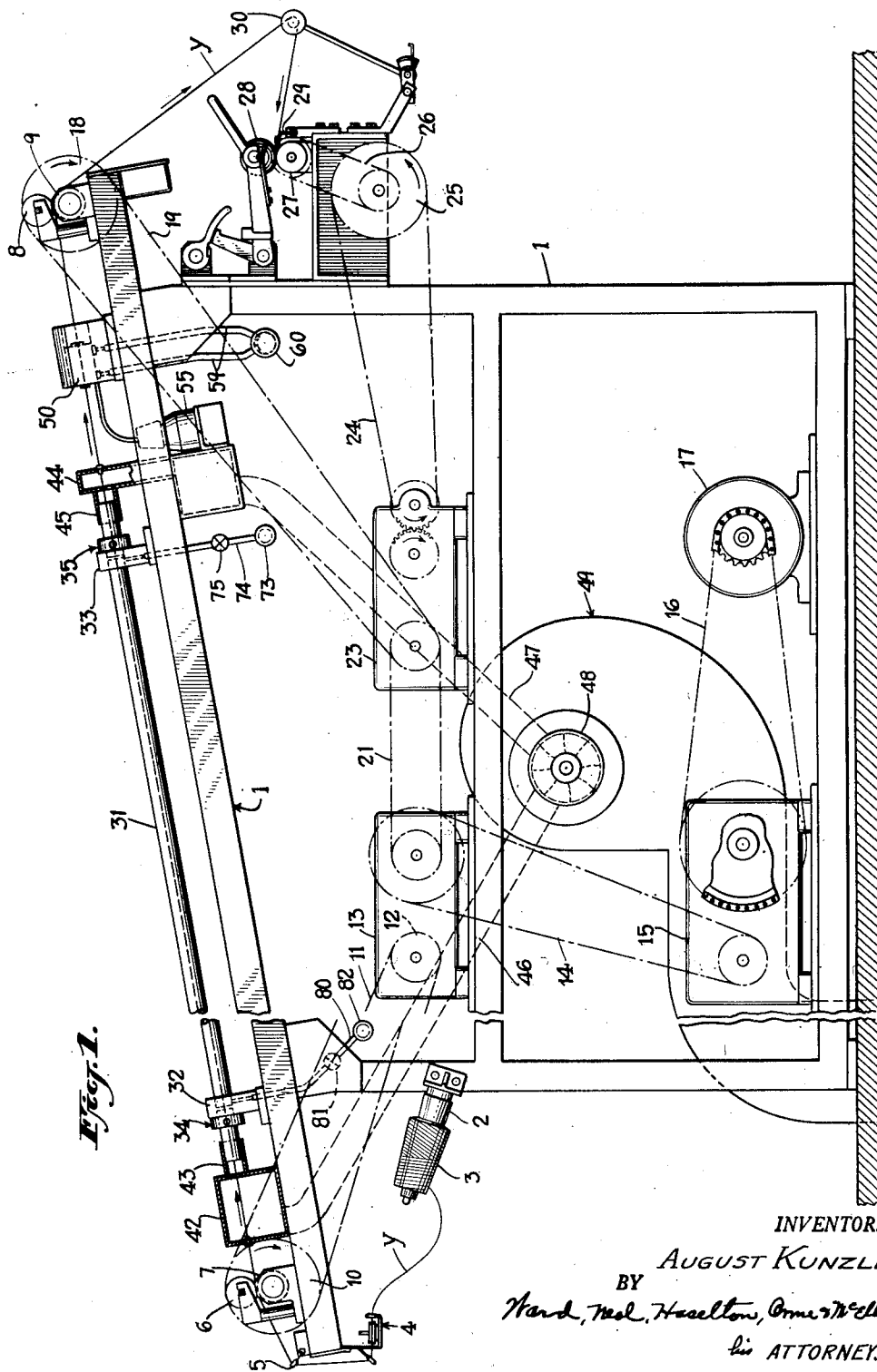
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2,790,298

APPARATUS FOR CRIMPING YARN

Filed March 11, 1954

6 Sheets-Sheet 1



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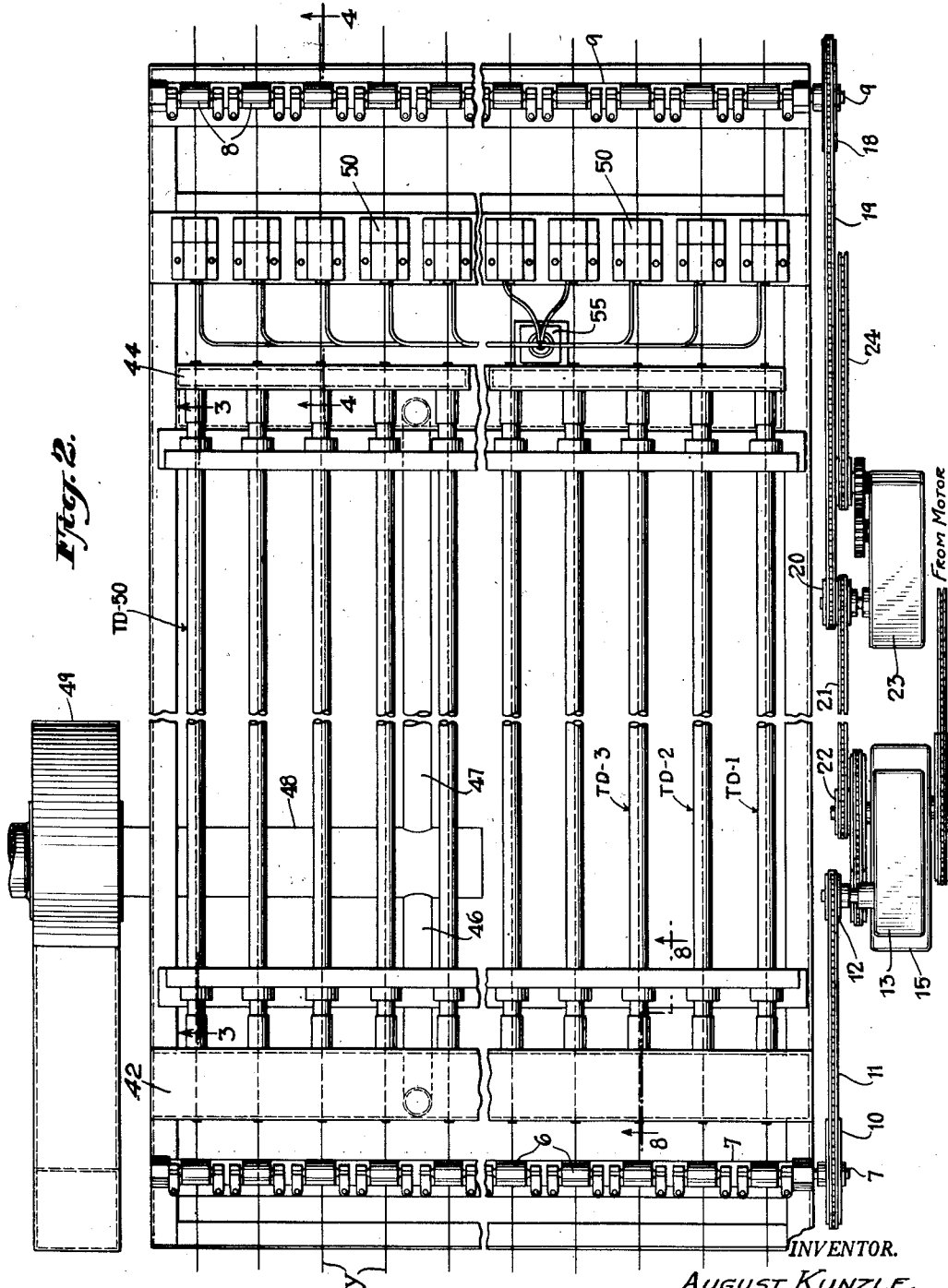
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APPARATUS FOR CRIMPING YARN

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6 Sheets-Sheet 2



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APPARATUS FOR CRIMPING YARN

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Fig. 3.

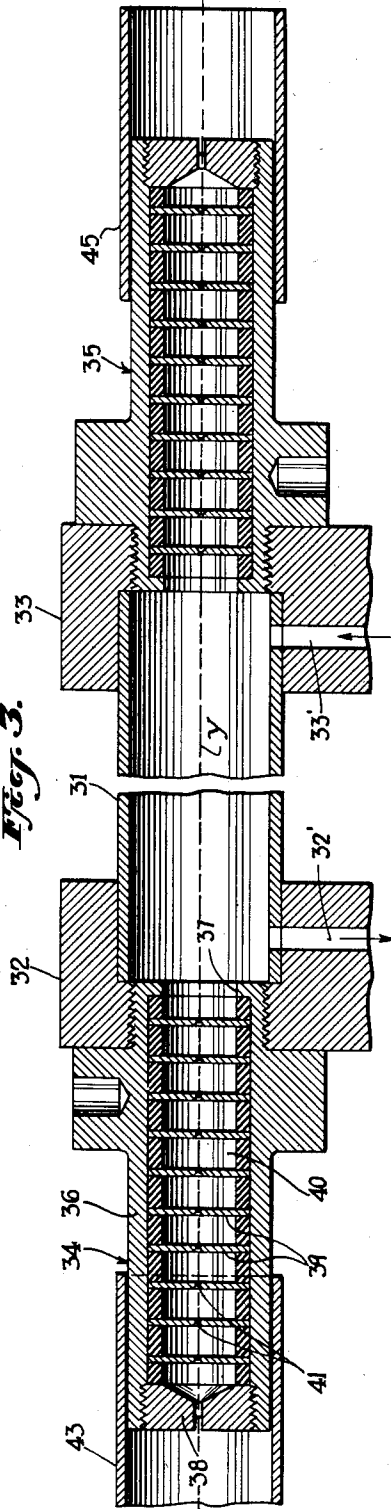
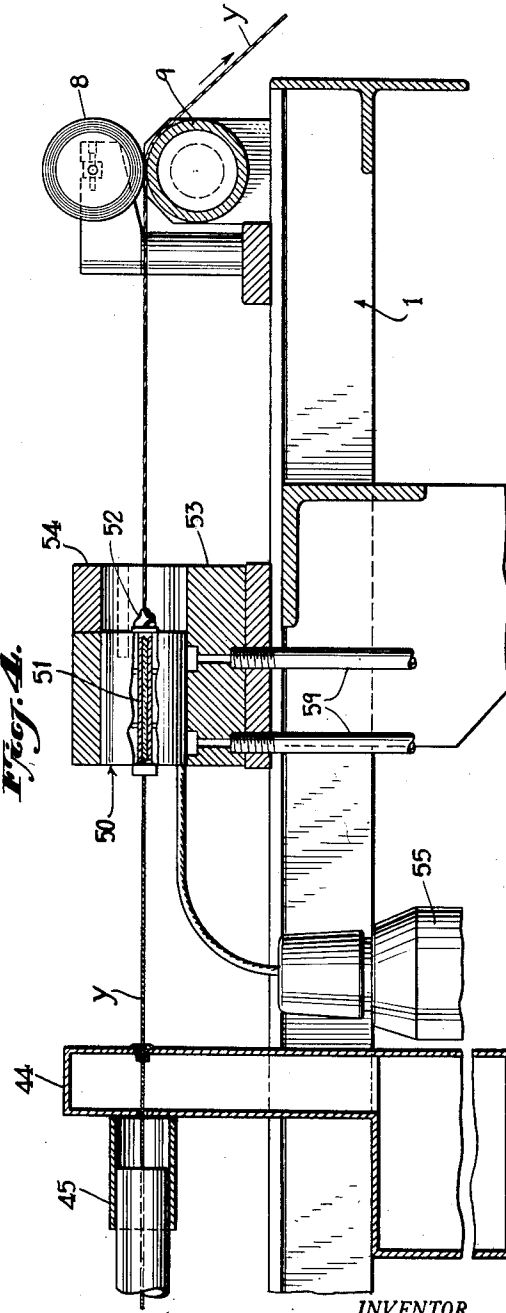


Fig. 4.



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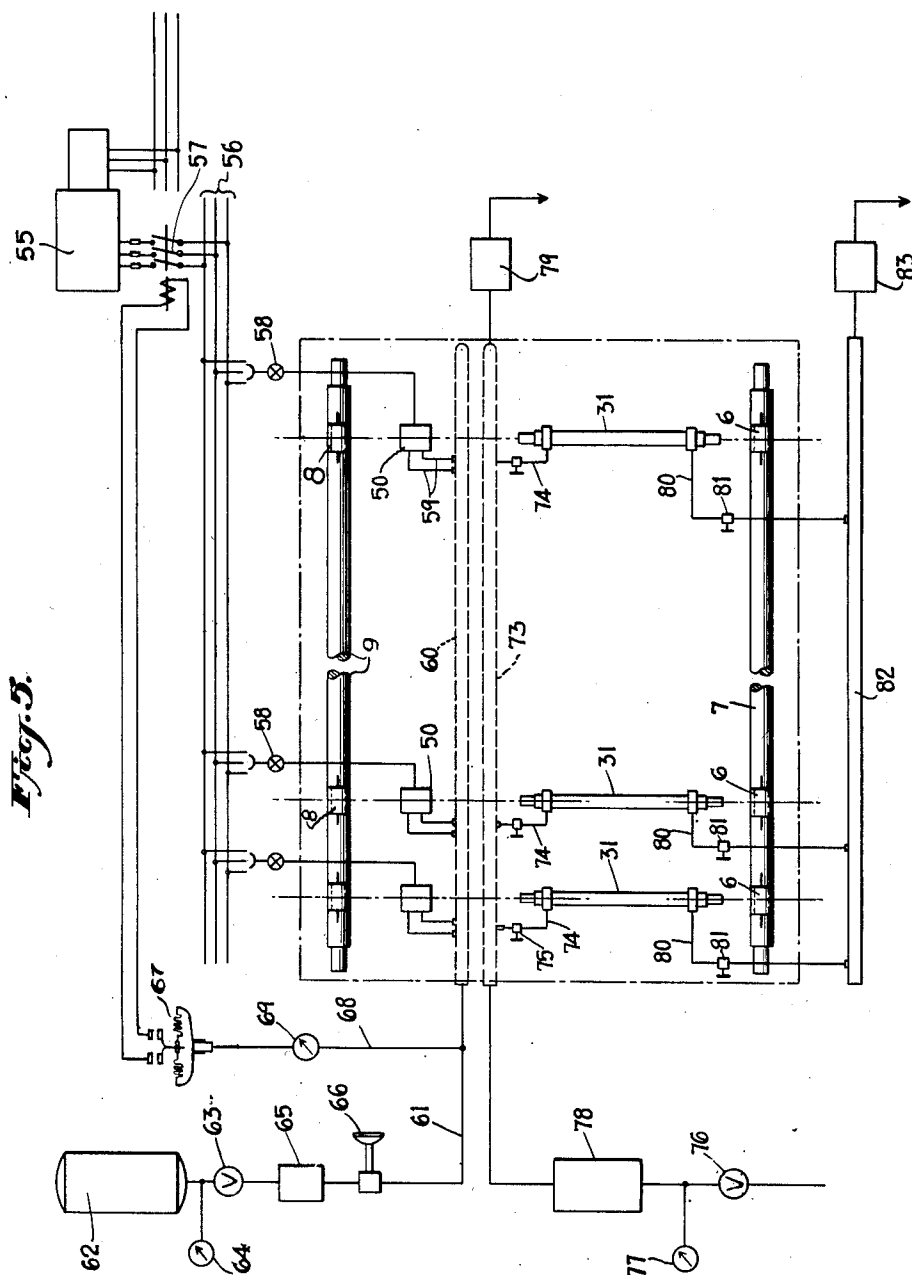
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Fig. 5.



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Fig. 6.

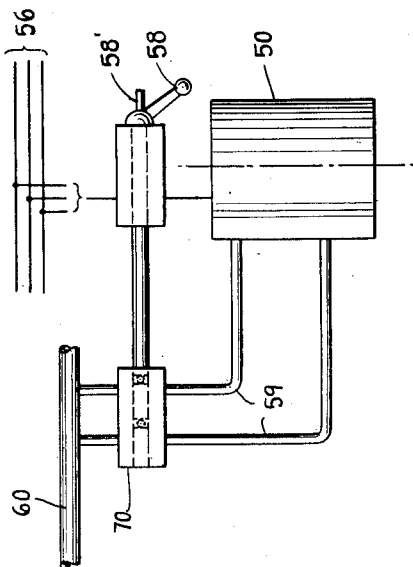


Fig. 8

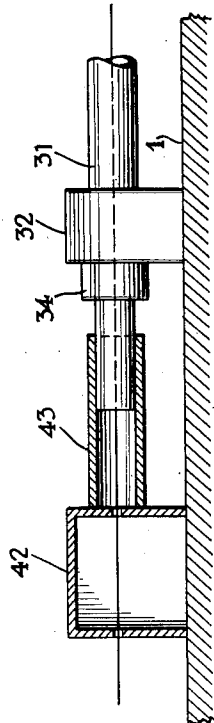
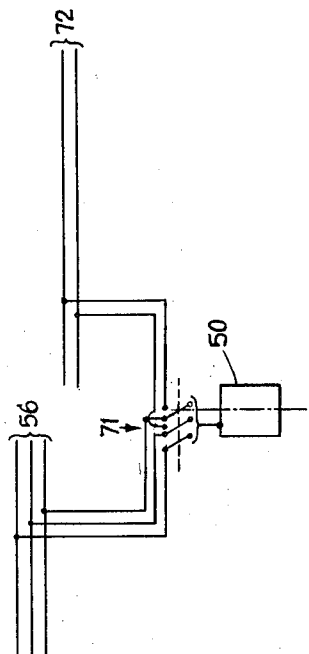


Fig. 7.



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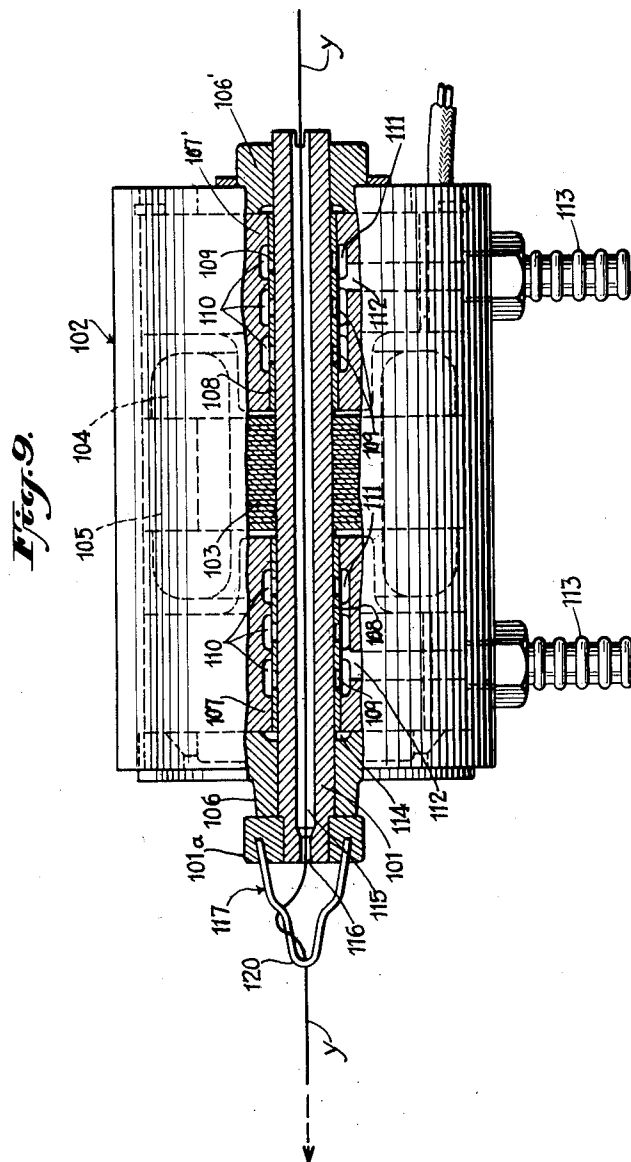
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6 Sheets-Sheet 6



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APPARATUS FOR CRIMPING YARN

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Application March 11, 1954, Serial No. 415,491

Claims priority, application Austria March 25, 1953

10 Claims. (Cl. 57—34)

This invention relates to apparatus for crimping yarn and more especially for permanently crimping synthetic linear organic polymer yarn by false twisting.

It has been heretofore proposed to provide apparatus to crimp cellulose and cellulose ester yarns, including heating same while twisting, but so far as I am aware no apparatus for this purpose has come into practical commercial use. So far as I know no commercial apparatus has heretofore been devised to treat a traveling linear synthetic organic polymer yarn under controlled tension prior to winding up. In addition, in the devices as heretofore proposed only a single yarn is treated and no proposal has been made to crimp simultaneously a series of yarns or to pass a single yarn, or several yarns, through such apparatus at speeds of the order of 20–40 meters per minute.

The principal object of the invention, accordingly, is to provide a simple, efficient apparatus of the kind described which shall be capable of treating such linear synthetic organic polymer yarn at such speeds under the conditions mentioned to produce a high-quality crimped yarn.

It will be understood that in producing permanently crimped nylon yarn it is necessary to control within predetermined critical limits certain functions, such as the rate of linear feed of the yarn, conditions and length of time of the setting operation, rotative speed of the twister, tension, etc. Therefore, in order to increase production, it is not only necessary to treat a large number of yarns simultaneously and to give each yarn individual treatment, but to provide apparatus which with certainty will produce exactly the same results on the individual yarns being treated.

It is another object of this invention to provide apparatus adapted to treat a multiplicity of yarns simultaneously and uniformly.

It is a further object of this invention to provide improved means for steaming the yarn under pressure during the twisting operation and during an appreciable part of the twisting path.

Further and other objects, features and advantages of the invention will more clearly appear from the detailed description given below, taken in conjunction with the accompanying drawings illustrating, by way of example, presently preferred embodiments of the invention, and in which:

Fig. 1 is an end elevation of an embodiment of the invention as viewed from the drive end with certain parts shown in section and others somewhat schematically;

Fig. 2 is a plan view of the apparatus shown in Fig. 1 with certain parts omitted for clarity;

Fig. 3 is a sectional view taken at 3—3 of Fig. 2 showing further details of the steaming tube and its pressure seals;

Fig. 4 is a sectional view taken at line 4—4 of Fig. 2;

Fig. 5 is a somewhat diagrammatic view showing the operative and control circuits;

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Fig. 6 is a somewhat diagrammatic view showing further details of the twister motor controls;

Fig. 7 is a similar view showing further controls for said motors;

Fig. 8 is a sectional view taken at 8—8 of Fig. 2; and

Fig. 9 is a side elevation, partly in section, showing a suitable twister unit.

Referring more particularly to Figs. 1 and 2, the apparatus is provided with a unitary frame designated in general as 1, on which is mounted a series of twisting devices (in the present embodiment, fifty in number) for handling simultaneously a like number of yarns. Said devices are individually designated in general (Fig. 2) as TD-1, TD-2, TD-3 . . . TD-50. These devices are arranged in parallel in plan view and at the same vertical level so that in end elevation only the first device TD-1 is seen (Fig. 1) together with certain parts and mechanisms common to all the devices.

Referring to Fig. 1, each of the individual yarn twisting devices, such as TD-1 . . . TD-50 is constructed and arranged and the several devices interrelated as follows:

Each said device has a support such as 2 secured to the frame 1 for carrying a yarn feeding bobbin, such as 3 to supply a yarn such as Y to yarn guides and brake unit such as 4, through which the yarn passes to a guide such as 5 (Fig. 1) mounted for lateral reciprocation on the upper portion of frame 1, individual guides 5 for the respective devices being preferably mounted on a common reciprocating bar. The construction and operation of such guides 5 are conventional and well known to those skilled in the art. Each device also has a first pair of conveying rollers such as feed rollers 6—7 mounted to receive the yarn passing through the corresponding guide 5, the roller 7 being the power roller and, in the present embodiment, being common to all of the twisting devices. On the opposite or output side of the machine a second pair of conveying rollers such as the draw rollers 8—9 is provided for each said device TD-1, etc., the roller 9 being the power roller and, in the present embodiment, being common to all of said twisting devices. In the alternative, separate rollers 7 and 9 could be used for the respective twisting devices and the series of rollers 7 and 9 could be mounted on common drive shafts respectively; the important thing being that the series of rollers 7 and the series of rollers 9 each be driven from a common source respectively. The power roller 7 has secured to one end thereof a sprocket wheel 10 (see also Fig. 2) in driven engagement with a chain 11 driven from a sprocket 12 on the output shaft of a variable speed transmission such as the device 13, which receives power through a chain drive 14 connected to the output side of a variable speed transmission such as the device 15, which in turn has its input side connected by a chain 16 to a source of power such as the electrical motor 17. The power roller 9 carries attached to its corresponding end a sprocket wheel 18 driven by chain 19 (Fig. 2) from the sprocket 20, which is connected through chain 21 to sprocket 22 and thence by chain 14 to the output side of the transmission 15. As will be seen from Figs. 1 and 2, the chain 21 drives a variable speed transmission such as the device 23 whose output is reversely connected to the drive chain belt 24, which through the intermediary of pulley 25 and chain belt 26, serves to drive a winding drive roller 27 common to all of the twisting devices and forming a part of the takeup device associated respectively with said twisting devices. The variable speed transmission devices 13, 15 and 23 may be the "P. I. V." (Link Belt Co., Chicago, Illinois) or "Reeves" (Reeves Pulley Co., Columbus, Indiana).

Each said takeup device comprises supporting means

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for a cross wound bobbin such as 28 whereby the bobbins may be individually moved into or out of operative engagement with the roller 27; and which takeup device also comprises a traverse guide such as 29 through which the yarn passes to the bobbin 28 and an adjustable tensioning device comprising a roller 30 around which yarn passes from the draw rollers 8—9. Such takeup mechanism is conventional and well understood to those skilled in the art.

It will be understood from the foregoing that the first conveyor rollers 6—7 for all of the twisting devices TD-1 . . . TD-50 are driven in synchronism from a common source, as also are the second pair of conveyor rollers 8—9 and the takeup devices 27—28. Furthermore, speed of the first conveyor rollers 6—7 and the speed of the second conveyor rollers 8—9 are adjustable relative to each other and the speed of the takeup devices 27—28 is adjustable, so that by proper manipulation of the variable speed units, the degree of tension to be imposed upon the yarns, the linear yarn feed and the takeup feed for all of the twisting devices may be simultaneously varied and the several yarns subjected to equal conditions. After the relative adjustments are made the over-all speed of the machine may be adjusted by the device 15; the yarn preferably being fed through the tubes 31 at a speed of 20—40 meters per minute.

Referring to Figs. 1 and 2: Each of the TD-1 . . . TD-50 devices comprises a plasticizing chamber which, in the present embodiment, takes the preferred form of a steam pressure tube 31 rigidly secured (Fig. 3) at its opposite open ends in blocks 32—33, which are rigidly secured to the frame 1. The tube 31 is provided at its respectively opposite ends with labyrinth seals 34—35 which are readily detachable from said tube 31 as by being in screw threaded engagement in the blocks 32 and 33, for the purposes to be hereinafter mentioned. Each of the labyrinth seals comprises a hollow chamber such as 36 provided at its inner ends with an internal flange such as 37 and at its outer end with a screw threaded plug such as 38. Within the chamber provided in 36 are disposed a plurality of diaphragm members 39 spaced apart axially of the chamber and extending in a direction transverse thereof so as to provide a plurality of chambers 40 which are one less in number than the number of diaphragms. The diaphragm members 39 and the plug 38 are provided with axially aligned orifices such as 41 which are preferably 0.6 millimeters diameter. It will thus be seen that the labyrinth seals provide at each end of the tube 31 a plurality of chambers such as 40 in which the steam pressure is gradually and successively reduced from the interior of the tube 31 towards the chambers 40 of the labyrinth seal situated most distant from the ends of the tube 31, i. e., as the yarn passes into the input end at the left and out of the output end of the right. The tube 31 is provided with an inlet port 33' for the entrance of steam and an outlet port 32' for the passage of condensate. As will be seen in Fig. 1 the tubes 31 are inclined upwardly from their input toward their output ends, preferably at an angle of from 2°—10°, to facilitate the drainage of condensate out of the ports 32'. Such condensate as may slowly accumulate in the bottom of the labyrinth seal chambers 40 may be removed when the machine is not in operation, by taking the seals apart, which may be readily done by the construction hereinafter pointed out. However, the removal of such condensate is required only at very long intervals of operation. Adjacent the input end of the seals 34 there is provided a common exhaust conduit 42 (Figs. 1 and 8) provided with openings in its opposite sides in axial alignment with the orifices 41 for the passage therethrough of yarns such as Y. To facilitate the threading of yarns, this conduit is spaced from the ends of the seals 34 and is connected thereto by adjustable sleeves such as 43 telescopically disposed exteriorly of the labyrinth cham-

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bers such as 36. Similarly the opposite or output labyrinth seals are provided with a common exhaust conduit 44 (Figs. 1 and 4) provided with axially aligned openings for the passage of yarns such as Y and similarly spaced from the ends of the labyrinth seals which are similarly provided with telescopic sleeves such as 45. It is noted that the width of the conduit 44 in the direction of yarn travel is quite narrow at the level of the yarn and increases in cross section below the uppermost frame member. The reason for this will be apparent hereinafter. The conduits 42 and 44 are in communication through branches 46 and 47 with an exhaust suction pipe 48 connected with a suitable exhaust fan assembly 49. The relatively narrow width of the header 44 (Figs. 1 and 4) at the yarn level makes possible an increased cooling zone without the expensive widening of the entire machine.

Each of the TD-1 . . . TD-50 units is provided with a twister such as 50 (Figs. 1 and 4). These twisters each comprise a hollow rotatable shaft 51 through which the yarns such as Y may be axially fed and at its output end the hollow shaft is provided with a twister element 52. The particular twister which we have found to be exceptionally suitable for this purpose is that described and claimed in co-pending application Serial No. 407,725, filed February 2, 1954. These twisters 50 (Figs. 1, 2 and 4) comprise a three-phase electric motor and are provided with compressed air bearings, the electrical and compressed air circuits and controls for which will be described hereinafter. Since these motors operate at very high rotative speeds (up to 200,000 R. P. M. or greater), they are securely mounted in heavy housings such as 53 (Fig. 4) provided with a removable hood portion 54 to facilitate threading the yarn.

Further structural details of the twister units 50 will now be described.

Referring more particularly to Fig. 9, the twister shaft is designated as 101 and is supplied with suitable motive means to drive the same at a high speed of the order of 50,000—150,000 R. P. M. and higher. In the present embodiment this motive means consists of an electric motor designated in general as 102 having a rotor 103 carried by the shaft 101 and a stator fixed to the housing of the motor 102 and consisting of an electrical winding 104 and a core 105. The shaft 101 is provided with end plates 106 and 106' which rotate with said shaft. The housing of motor 102 is provided with bearing blocks 107 and 107' disposed adjacent said end plates 106—106' in which are provided suitable compressed air bearings. In general, such bearings may be constructed and arranged in a manner now to be described. The bearing blocks are provided with axial bores in alignment with the shaft 101 and each of which has rigidly secured therein, as by a press fit, a bearing sleeve such as 108 whose internal diameter is sufficiently larger than the external diameter of the shaft 101 so as to function in the manner to be hereinafter described. For example, the difference between the internal diameter of the sleeve 108 and external diameter of the shaft 101 may be of the order of 0.01—0.03 millimeter and will depend upon the degree of air pressure employed. The sleeves such as 108 are each provided with a plurality of relatively small holes such as 109 disposed peripherally thereabout and in communication with a series of annular channels 110 interconnected by a common passage such as 111 in communication with the bore 112 adapted to receive air under pressure from a suitable source connected to the tube such as 113. The air pressure should be of the order of two atmospheres and preferably greater.

The clearance between the shaft 101 and the bearing sleeve 108 is such that the shaft is supported free of contacts with the walls of the sleeves by means of the compressed air and the compressed air passing outwardly passes through cavities such as 114 found on the inner faces of the plates 106 and 106' and outwardly through

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the space between the end plates 106—106' and the bearing blocks 107 and 107'. The clearance between end plates 106 and 106' and the respective portions of the bearing blocks 107 and 107' is such that said blocks are held out of contact with said plates by said compressed air.

The shaft 101 is provided with an axial bore 115 extending therethrough from the input or right hand end thereof to the output or left hand end thereof for the passage of yarn traveling in a path along an axis $y-y$ of linear feed. The bore 115 at the output end of the shaft and immediately adjacent thereto is provided with a throat 116 of reduced diameter extending for a limited axial distance. In the present embodiment, for conveniences of construction, the output end of the shaft is provided with a sleeve portion 101a rigidly secured thereto and forming a part thereof. The twisting loop 117 is secured to the end 101a of said shaft.

From the foregoing it will be understood that each of the sub-assemblies of TD-1 . . . TD-50 comprises the various parts above referred to arranged in axial alignment so that the respective yarns passing therethrough may be fed along a straight linear feed axis. The telescopic conduit branches such as 43 and 45 (Figs. 1 and 3) and the removable labyrinth seals 34 and 35 and the removable twister hoods 54 all facilitate threading the yarn.

The length of the tubes 31 is preferably 1 meter and the length of each of the labyrinth seals is of the order of 7 centimeters. The distance from the output ends of the seals 35 to the input of the twister head is preferably at least 5 centimeters to permit a suitable cooling zone between the plasticizing chamber and the twister. The steam tubes 31 are adapted to withstand and maintain relatively high steam pressures of at least one atmosphere and up to five atmospheres or greater.

Referring more particularly to Fig. 5, the motors of the twisters 50 (schematically shown) are three-phase motors with short circuit rotor and are supplied by a three-phase medium frequency generator 55 over a circuit net 56. The entire net is under control of a switch 57 and each motor is under individual control of a separate switch such as 58. The air bearings of the respective twisters 50 are supplied with pressure air through individual branch lines 59 connected to a common manifold 60 which in turn is connected by a common line 61 to a suitable source of pressure air designated 62. The line 61 is provided with a stopcock 63, a pressure gauge 64, a filter 65, and a reduction valve 66. A pressure relay 67 is connected to the line 61, intermediate the reduction valve 66 and manifold 60, by means of a line 68 provided with a pressure gauge 69. The pressure relay 67 actuates the switch 57 and is constructed so that when the pressure in the line 61 falls below the predetermined pressure the relay 67 opens the switch 57 to disconnect the twisters 50. In this way the twisters are protected against damage in the event that the pressure supplied to the bearings falls below the minimum required to safely support the twister shaft 51 (Fig. 4).

It is further important that no pressure air should be supplied to the motors when the motors are cold, since condensation of moisture could take place from the compressed air with the resultant danger of corrosion. To prevent this the following provision is made: A suitable air valve 70 (Fig. 6) is disposed in the branch lines 59 of each twister 50 and is held in closed position when the switch 58 is open, as shown in Fig. 6. This valve is suitably clutched to the switch 58 so as to normally lock the switch 58 in open position when the air valve is closed. Provision is made for opening the air valve 70, as by pressing the pin 58', which automatically unlocks the switch 58 for operation.

In Fig. 7 an alternative means is illustrated for preventing moisture condensation. In this embodiment the following provision is made for heating the twisters 50 when the electrical motor is not operating to rotate the

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shaft 51. A changeover switch 71 is built in the current supply line to the motor of each twister 50 which connects the motor with either the medium frequency net 56, for rotation of the motor, or connects two phases of the motor winding with a regular alternating current line 72 to thereby supply heat to the motor while it is not operating to rotate the shaft.

The supply of steam for the steam pressure tubes 31 is provided from a common supply line 73 and interconnected to individual steam tubes by branch lines such as 74 (connected to the inlet ports such as 33' of Fig. 3) and provided with valves such as 75, and the main line 73 is provided with a main valve 76 and with a pressure gauge 77. The exact pressure desired is obtained by a suitable pressure control valve designated as 78. The line is suitably provided with a condensation pot 79 having the usual condensation drain connection.

The tubes 31 are preferably inclined at an angle of not less than 2° to make it possible for the condensation water produced in the tube to be drained off unhindered through individual drain lines such as 80, connected at one end to the outlet ports 32' (Fig. 3). The lines 80 are supplied with individual valves 81 and their other ends are connected to a common manifold 82 which is connected to a suitable condensation pot 83 having the usual drain line. The steam tubes 31 may, of course, be level, but this will make it more difficult to remove the condensate.

Having thus described my invention with particularity with reference to presently preferred embodiments thereof, it will be obvious to those skilled in the art, after understanding my invention, that various changes and modifications may be made therein without departing from the spirit and scope of my invention, and I aim in the appended claims to cover such changes and modifications as fall within the scope of the invention.

What I claim is:

1. In apparatus for permanently crimping synthetic filament yarn, the combination of a series of false twisting devices each comprising yarn supply means, a first yarn conveying device for receiving yarn from said supply means, a device for steaming yarn under pressure of at least one atmosphere, a motor operable at high rotative speed and having a hollow shaft with a twister attached at one end, a second yarn conveying device, and a yarn takeup device, said first and second conveying devices, steaming device, hollow twister shaft and attached twister being arranged in alignment for the linear feed of said yarn in a straight line, and common means for operating said series of false twisting devices.

2. Apparatus as set forth in claim 1 in which individual short steam conduits are operatively connected to said pressure steaming devices of said series of false twisting devices respectively, and said short conduits are operatively connected to a common supply line which is provided with pressure control means, whereby steam pressure may be simultaneously uniformly controlled in all of said pressure devices.

3. Apparatus for the production of crimped synthetic filament yarns which comprises a steaming tube, provided at its input and output ends respectively with labyrinth seals each having a multiplicity of axially spaced partitions provided with nozzle-shaped passageways in alignment for the passage of yarn therethrough, the passageways being of the order of 0.6 millimeters diameter, to thereby permit a steam pressure of at least one atmosphere in said steaming tube.

4. Apparatus as set forth in claim 3 in which the steaming tube is inclined upwardly from its input end to its output end at an angle of at least 2° .

5. Apparatus as set forth in claim 3, in which each labyrinth seal consists of a hollow chamber detachably secured to the respective end of said steaming tube and provided with a plurality of diaphragm members disposed within said hollow chamber extending in a direc-

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tion transverse its axis and spaced apart axially, said diaphragms having axially aligned orifices to jointly provide aligned entrance and exit passageways for said steaming tube, to thereby provide a plurality of chambers in which the steam pressure is gradually reduced from the interior of said steaming tube toward the chambers of the labyrinth seals situated most distant from the ends of said steaming tube.

6. Apparatus as set forth in claim 3 wherein each labyrinth seal consists of a hollow chamber detachably secured to the adjacent end of said steaming tube and provided with a number N of diaphragm members disposed within said hollow chamber extending in a direction transverse its axis and spaced apart axially, said diaphragms having axially aligned orifices to jointly provide aligned entrance and exit passageways for said steaming tube, to thereby provide in each labyrinth seal N—1 of chambers in which the steam pressure is gradually reduced from the interior of said steaming tube toward the chambers of the labyrinth seals situated most distant from the ends of said steaming tube.

7. Apparatus as set forth in claim 3 in which each labyrinth seal consists of an elongated chamber detachably secured at one end to the respectively adjacent end of said steaming tube, said chamber being provided at one end with an internal seat, a plurality of diaphragm members disposed within said chamber extending in a direction transverse its axis and spaced apart axially, a removable retaining member disposed in the opposite end of said chamber for holding said diaphragms therein against said internal seat and provided with a central opening for the passage of yarn therethrough, said diaphragms having axially aligned orifices jointly providing a passageway through said labyrinth seal, to thereby provide at the entrance and exit of said steaming tube a plurality of chambers in which steam pressure is gradually reduced from the interior of said steaming tube toward the chambers of the labyrinth seals situated most distant from the ends of said steaming tube.

8. In apparatus for permanently crimping yarn, the combination of a series of false twisting devices each comprising a first yarn conveying device for receiving yarn from a suitable source of supply, a yarn plasticizing chamber, an electric motor operable at high rotative speed and having a hollow shaft journaled in compressed air bearings and provided with a twister, a second yarn conveying device, and a yarn takeup device, said conveying devices, yarn plasticizing chamber, hollow twister shaft and attached twister being arranged in alignment for the linear feed of said yarn in a straight line, a common electrical power line connected to said series of motors, a common compressed air supply line connected to the compressed air bearings of said series of motors, an electrical switch controlling said electrical power line, an air-pressure actuator for said switch and in communication with said air supply line and adapted to actuate said switch to open position when the pressure in said air supply line drops below a predetermined

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minimum pressure, to thereby stop the operation of said motors when the compressed air supplied to said bearings is insufficient operatively to support said shafts.

9. In apparatus for permanently crimping yarn, the combination of a series of false twisting devices each comprising a first yarn conveying device for receiving yarn from a suitable source of supply, a yarn plasticizing chamber, an electric motor operable at high rotative speed and having a hollow shaft journaled in compressed air bearings and provided with a twister, a second yarn conveying device, and a yarn takeup device, said conveying devices, yarn plasticizing chamber, hollow twister shaft and attached twister being arranged in alignment for the linear feed of said yarn in a straight line, a common source of power for said first and second conveying devices and said yarn takeup devices of said series of yarn-twisting devices, three drive shafts drivingly connected to said series of first conveyor devices and said series of second conveyor devices and said series of yarn-takeup devices respectively, and variable speed transmissions connected to said common source of power and said three shafts and adapted to vary the speed of said three drive shafts individually and collectively.

10. In apparatus for permanently crimping yarn, the combination of a series of false twisting devices each comprising a yarn plasticizing chamber, an electric motor operable at high rotative speed and having a hollow shaft journaled in compressed air bearings and provided with a twister and yarn conveying and tensioning means for receiving yarn from a suitable source of supply and moving the same through said chamber and hollow shaft and twister at a predetermined tension, said yarn conveying and tensioning means, yarn plasticizing chamber, hollow twister shaft and attached twister being arranged in alignment for the linear feed of said yarn in a straight line, a common electrical power line connected to said series of motors, a common compressed air supply line connected to the compressed air bearings of said series of motors, an electrical switch controlling said electrical power line, an air-pressure actuator for said switch and in communication with said air supply line and adapted to actuate said switch to open position when the pressure in said air supply line drops below a predetermined minimum pressure, to thereby stop the operation of said motors when the compressed air supplied to said bearings is insufficient operatively to support said shafts.

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