April 27, 1965 A. TONOLO 3,179,974

STRETCHING FRAME

Filed March 7, 1962 3 Sheets-Sheet 1

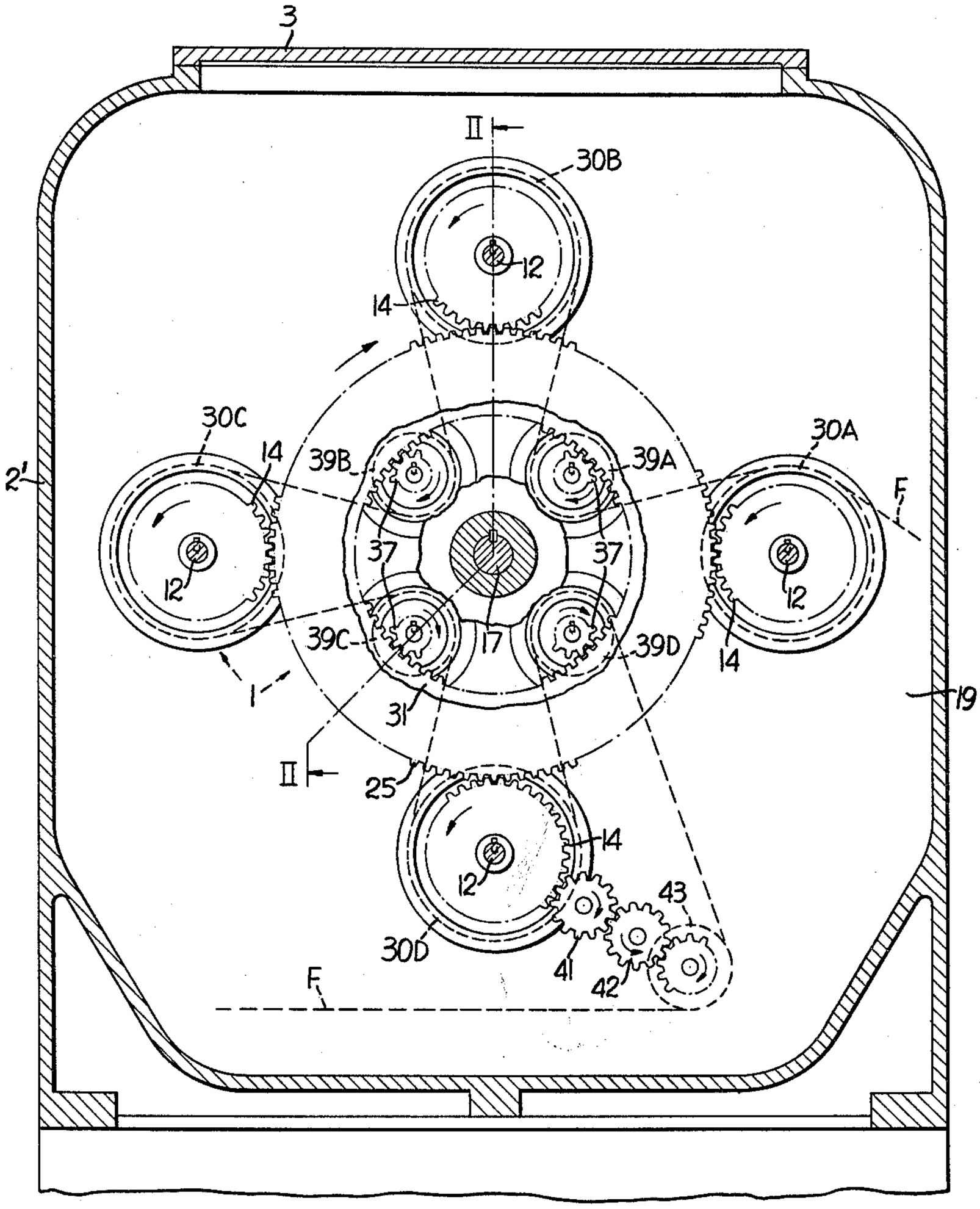

Fig. 1

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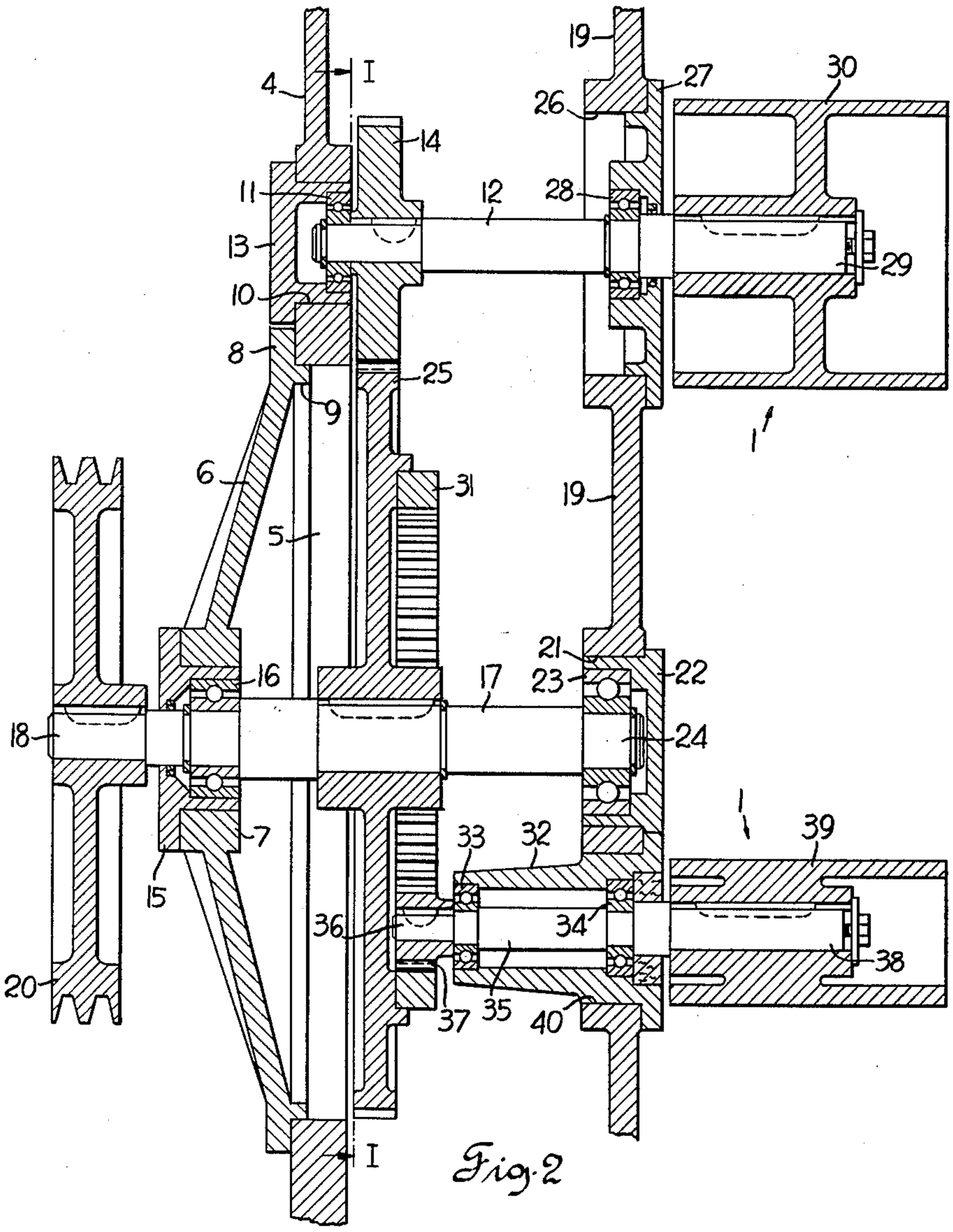

Fig. 2

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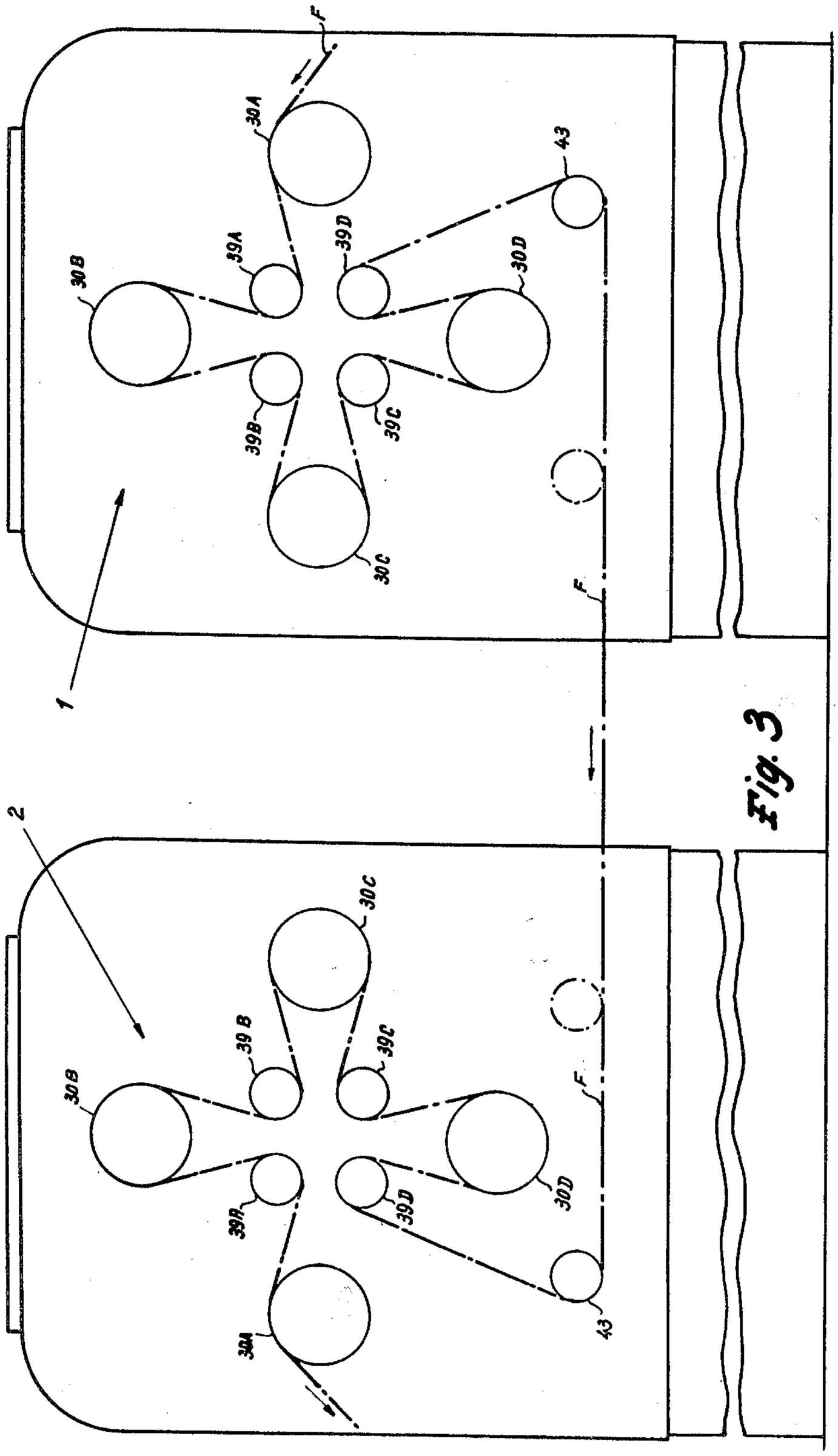

Fig. 3

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3,179,974
STRETCHING FRAME

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3 Claims. (Cl. 18—1)

This invention relates to devices which are commonly known as stretching or drawing frames for stretching and orienting synthetic or artificial monofilaments.

The purpose of such operation is to bring the monofilaments to the desired final diameter by increasing their strength and toughness and reducing their brittleness.

As it is well known, the materials which are most suitable for providing monofilaments which can be subjected to a stretching operation are polyamide, polyethylene and polyvinyl resins etc., which give fibres which are better known in commerce under the names nylon, decalon, vislene, tricovil, etc. The monofilaments are drawn in a molten condition in suitably designed dies and as the filament comes out from the hole in the die it is immediately cooled by a cold inert gas stream or in water so that it solidifies and is then rapidly wound on a first group of rolls at a speed which is not very high. The effective diameter of the filaments thus obtained, besides being determined by the diameter of the holes through which the molten mass of polyamide resin is forced, is also determined to a large extent by the feed pressure and the winding speed of the filaments. Said filaments are then subjected to a cold or hot stretching process, depending upon the material, during which they are stretched from two to ten times their original length. During such stretching process the long-chain molecules, which are disposed at random in the unstretched fibre, assume an orderly arrangement. They become parallel to each other and in addition closer to each other. As a result of such stretching the filament becomes resistant and resilient in addition to being tough.

In practice the stretching takes place between the winding on the first group of rolls and a second group of rolls having the same size as those of the first group but rotating at a speed several times higher, depending on the stretching ratio required. In this way the filament increases its initial length on the basis of a predetermined ratio with a resultant reduction in its initial diameter.

Without going into details of the stretching process which are well known to those skilled in the art, it should be noted that in the stretching frames so far used, which consist generally in groups of rolls disposed horizontally or vertically and driven by transmission chains or individual gears, substantial disadvantages occur such as for example:

(*a*) Either the chains or the gears, owing to the long path or the large number of gears required, respectively, because of the back-lash and wear, cause vibrations which jeopardize the uniformity of the cross-section of the filaments.

(*b*) The stretching speed is limited by the complexity of the transmission which does not allow very high speeds.

(*c*) It is required to employ a large number of rolls to obtain the adhesion required for stretching and a linear and parallel arrangement of the filaments.

(*d*) It is required to employ a single drive for all sets of rolls to have the exact speed ratio between them.

It is an object of this invention to provide a stretching frame comprising at least two groups of rolls having different peripheral speed, which reduces to a minimum the number of gears involved thus avoiding the above said disadvantages.

More particularly, the stretching frame according to

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this invention is characterized in that it comprises for each group of rolls, a first set of gears which are disposed with their axes along a circumference and are each integral with a roll of a first set of rolls having a given diameter, and a second set of gears, disposed along a circumference concentric to the circumference of the first set, and each integral with a roll of a second set of rolls having a larger diameter, said rolls having the same peripheral speeds as that of the rolls of the first set, the rolls of the first set being disposed in alternate relation with the rolls of the second set so that the filament alternatively engages the outer surface of a roll of one set and the inner surface of a roll of the other set to assure thus the adhesion required for the stretching.

This invention will be now described in greater detail with reference to an embodiment thereof, given by way of example only and therefore in no limiting sense, which is illustrated in the accompanying drawings, wherein:

FIG. 1 is an elevational view, partially in section of a group of rolls of the stretching frame according to the invention taken along line I—I in FIG. 2;

FIG. 2 is an enlarged cross-sectional view along line II—II in FIG. 1; and

FIG. 3 is an elevational somewhat diagrammatic view of two groups according to the invention between which the stretching takes place.

Referring now to FIGS. 1 and 2, there is illustrated therein a group of rolls indicated generally by the reference **1**. Said group is mounted outwardly of a casing **2'** provided with a cap **3** and including the driving gears of the rolls in an oil bath. The wall **4** of the housing is provided with a central circular aperture **5** in which a circular convex plate **6** is secured having at its center a hollow hub **7**. The plate **6** is provided with a peripheral flange **8** and an abutment **9** intended for fitting in the aperture **5**. The flange **8** is secured to the wall **4** by usual means (not shown). In the wall **4** concentrically to the aperture **5** four holes **10** are provided adapted to receive each a bushing **13** for a bearing **11**, in which the end of a shaft **12** is secured extending perpendicularly to the wall **4**. On the shaft **12**, adjacent to the bearing **11** a gear **14** is keyed. The hollow hub **7** of the plate **6** receives a flanged sleeve **15** in which a bearing **16** is inserted carrying a shaft **17** having a projecting end **18** on which a pulley **20** is keyed. The shaft **17** extends through the hole **5** in the wall **4** unto another wall **19** of the housing. Said wall bears a hole **21** at the axis of the shaft **17** in which a flanged sleeve **22** is inserted for receiving a bearing **23** in which the end **24** of the shaft **17** is secured. The shaft **17** is thus secured perpendicularly to the walls **4** and **19** of the housing. In an intermediate position of the shaft **17** a gear **25** is keyed having a large diameter and outer teeth engaging the gear **14** on the shaft **12**. In the wall **19**, in line with the holes **13** in the wall **4** four radial holes **26** are provided each carrying a plate **27** for supporting a bearing **28** through which the shaft **12** extends which is thus secured in a position perpendicular to the two walls. The end **29** of the shaft **12** projecting from the wall **19** carries a roll **30** keyed thereon having a large diameter which is rotated by the shaft **12**. On the gear **25** a tooth wheel rim **31** with inner teeth is secured having a diameter smaller than the diameter of the gear **25**. On the wall **19** four further radial holes **40** are provided which are staggered by 45° with respect to the holes **26**, in each of which a flanged sleeve **32** is inserted carrying two bearings **33** and **34** which serve as a support to a shaft **35** having at an end **36** a small diameter gear **37** meshing with the tooth wheel rim **31** and at the other end **38** a small diameter roll **39**. In this manner, as it is seen in FIG. 1, four large rolls **30A**, **30B**, **30C** and **30D** are provided which are arranged symmetrically and radially about the

periphery of the gear **25** and meshing therewith, and four small rolls **39A**, **39B**, **39C** and **39D** which are arranged radially about the tooth wheel rim **31** and meshing therewith, but staggered by 45° with respect to the large rolls **30**. The transmission ratio of the various gears is chosen so that all of them have the same peripheral speed. The four large rolls rotate outwardly with respect to the four small rolls. In this way the adhesion for the stretching is improved since the filament F encircles the large rolls **30** by more than a half circumference. The filament F enters the group **1**, passes on the roll **30A**, then on the inner surface of the roll **39A**, then on the outer surface of the roll **30B**, on the inner surface of the roll **39B**, on the outer surface of the roll **30C**, on the inner surface of the roll **39C**, on the outer surface of the roll **30D**, on the inner surface of the roll **39D** and then on an additional roll **43** driven by two gears **41** and **42** meshing therebetween, to go out from the group **1** and enter another group **2** (FIG. 3) quite similar to the group **1** but having its rolls which rotate at a speed which is several times higher (from 2 to 10 times depending upon the material used). Therefore, a stretching of the filament F takes place between the group **1** and the group **2**.

There has been thus provided a simple stretching frame which eliminates any oscillations of the moving parts, establishes a maximum adhesion by means of a limited number of rolls and which allows a high speed owing to the fact that there is a direct transmission between two gears.

It is apparent that by means of such a device the stretching of the filaments can be graduated, if desired, by providing a larger or smaller number of rolls.

While but one embodiment of the invention has been illustrated, it is apparent that a number of changes can be made therein, such as for example in the independent drive of the groups which can be of a mechanical or electronic nature, without departing from the scope of the invention. For example, the gears of the outer set, instead of being driven by a tooth wheel rim, could be driven by individual intermediate gears meshing with the tooth wheel rim engaging the gears of the inner set.

I claim as my invention:

1. A stretching frame for simultaneously stretching a plurality of monofilaments of synthetic material comprising at least two groups of rolls having different peripheral speeds on which the monofilaments pass, each group of rolls comprising

(*a*) a set of inner gears which are disposed with their axes along an inner circumference,

(*b*) a set of inner rolls,

each of said inner rolls being connected to one of said inner gears and having a substantial length and a given diameter,

(*c*) a set of outer gears which are disposed with their axes along an outer circumference which is larger than and concentric with said inner circumference,

(*d*) a set of outer rolls,

each of said outer rolls being connected to one of said outer gears and having a substantial length and a diameter which is larger than said given diameter, said inner and outer rolls having the same peripheral speeds, said inner and outer rolls being spaced apart from each other and being disposed in alternate relationship with each other so that each of said plurality of monofilaments alternately engages the outer surface of an outer roll and the inner surface of an inner roll, and each adjacent pair of inner rolls being spaced apart from each other a distance which is less than the diameter of an outer roll thereby to assure adhesion of said monofilaments to said outer rolls to effect stretching,

(*e*) and gear means for driving said set of inner gears and said set of outer gears.

2. The combination according to claim 1 wherein said gear means comprises a gear having two concentric tooth wheel rims and wherein said set of inner gears meshes with one of said rims and said set of outer gears meshes with the other of said rims.

3. The combination according to claim 2 wherein said one of said rims has a smaller diameter than said other of said rims.

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