GOVERNMENT OF INDIA : THE PATENT OFFICE, 214, ACHARYA JAGADISH BOSE ROAD, CALCUTTA-17.

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A FILAMENT WINDING MACHINE FOR FABRICATION OF FILAMENT-WOUND FIBREGLASS REINFORCED PLASTIC CYLINDERS

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The following specification particularly describes and ascertains the nature of this invention and the manner in which it is to be performed :—

This is an invention by VINJAMURI GOPALA KRISHNA, Scientist, HAROGOPPA SUBBASASTRY PRABHAKARA SASTRY, Senior Draughtsman, MOHAMED JAFFER MOHIADIN, Senior Draughtsman, all of the National Aeronautical Laboratory, Bangalore-17, all Indian citizens.

This invention relates to a filament winding machine for fabricating fibre reinforced plastic structures and is particularly concerned with an indigeneous design, for import substitution of the said machine. Fibre reinforced plastic structures are light and have good mechanical and electrical properties, chemical resistance and as such find application in aeronautical, electrical and chemical industries, space technology as well as in general applications such as in agricultural equipment and building construction.

Filament winding technique and the construction of any type of mechine is virtually not known in India.

The object of the invention is to meet the expected demand of equipment and know-how from reinforced plastics industry in India, which if imported would involve considerable amount of foreign exchange.

Filament winding process consists of utilizing strong glass filaments and a suitable resin combination for fabricating cylindrical parts with high strength to weight ratio.

Cylindrical filament wound parts are generally fabricated by winding resin wet glass filaments on to a continuously rotating mandrel. The wound part is then cured and removed from the mandrel. The composite material thus obtained must have uniform structure which depends on the consistancy of the winding process. Any variation in process parameters such as resin wetting, spacing of successive fibres, angle of winding, precuring, roving feets, mandrel speeds, winding tension would considerably affect the strength of the final product. In effect filament winding is a controlled process and is achieved only by automatically controlled process for product quality reproduction.

According to this invention a filament winding machine for fabricating of filament-wound fibreglass reinforced plastic cylinders comprises a mandrel drive system and a feeder with feeder drive system with an adjustable roving feed head, separate means to drive the said mandrel drive system and feeder system, electrical circuit means for individually starting and stopping the said mandrel drive system and feeder drive system, a resin wetting system including an excess resin remover for wetting the fibreglass filaments, a precuring chamber, a pulley means to adjust the tension of the roving and an electrical tension measuring device to indicate the tension of the said roving wetted by the said wetting system.

The main elements of the machine are :—

(i) (a) A mandrel drive system consisting of a three phase electric motor, a reduction gear box and a mandrel mount and the associated operation for obtaining different mandrel speeds.

(b) A feeder drive system consisting of an electric motor, a lever operated gear box, a feeder carriage, a screw rod to facilitate feeder carriage reciprocating motion, limit switches, safety limits and a roving feeder arm.

(ii) An electrical circuitary as generally described in Fig. 3 of the accompanying drawings, for individually starting and stopping the mandrel drive system and the feeder drive system, and an electrical coupling for simultaneously starting and stopping the two systems.

An assembly of the system generally comprises a fibre glass roving mount 27 with variable speed drive 19 for adjusting the fibre tension, resin wetting system including an excess resin remover, precuring chamber 20, tension adjuster pulley 21, electrical tension measuring device 22, adjustable roving feed head attached to the feeder 13, fume duct 23 and superstructure 17 for mounting fibreglass roving 1, resin wetting system, precuring chamber 20, tensioner, tension measuring device 22, fume duct 23, console for housing the electrical circuitary as generally described in Fig. 3 of the drawings.

Specification

Capacity :	a.	Maximum diameter	140 mm
		Minimum diameter	25 mm
	b.	Maximum length	750 mm
	c.	Winding angles	30 degrees (Helical) to 89 degrees (Circumferential)
	d.	No. of mandrel speeds	8
	e.	Max. feeder speed	3.1 m/min.
		Min. feeder speed	0.47 m/min.
	f.	No. of feeder speeds	27
	g.	Power supply	440 V,3ph,50Cycles AC
	h.	Electrical drive units	Two 1 HP, 3 phase motors
	i.	Floor space requirements	3 ½ m × 4m

The invention will now be described with the help of accompanying drawings wherein :

Figure 1 is schematic diagram of the filament winding machine;

Figure 2 is a perspective view of the filament winding machine; and

Figure 3 is a control circuit diagram.

Filament winding basically consists of laying fibreglass filaments 1 (or rovings) wetted with a suitable binder material, on to a continuously rotating mandrel 2. The wound part is removed from the mandrel 2 after the binder is allowed to set. The mandrel 2 is driven by a mandrel drive system consisting of a three phase electric motor 3, a reduction gear box 4, step cone pulleys 5 and a mandrel mount 6.

The carriage 7 is provided with a drive system consisting of an electric motor 8, a lever operated gear box 9, a screw rod 10 to facilitate the carriage 7 reciprocating motion, limit swiches 11, safety limits 12 and feeder 13.

An electrical circuitary is provided as generally described in Fig 3 of the drawings for individually starting and stopping the mandrel drive system and feeder drive system and an electrical coupling is provided for simultaneously starting and stopping mandrel 2 and carriage 7

The wetting system consists of a regulated feed of resin through a funnel 14 onto the fibre glass roving 1 during the winding process and a pulley 15 and a plastic squeezer 16 to secure uniform wetting of the resin and control of resin content

This the assembly comprises a superstructure 17 on which are mounted fibreglass spool 18 with a tension control system 19 for adjusting the fibre tension, resin wetting system including a squeezer 16, precuring chamber 20, tension adjuster pulley 21, Electrical tension measuring device 22, an adjustable roving feeder 13, fume duct 23, a console 24 for housing the electrical circuitary (as generally described in fig 3 of the drawings) tension measuring equipment 22, fuses and control display panel 25 for easy operation

Referring to the Fig 1 of the accompanying drawings the important components for the filament winding machine are two electrically coupled motors 3, 8 for driving mandrel 2 and the carriage 7, limit switches 11 for reversing the direction of rotation of the carriage drive motor 8 are fixed The tripping of the limit switches is achieved by the adjustable cam 26, and limit switches 12 are the safety devices in case of carriage traverse failure Glass fibre roving 1 wetted with a suitable binder, (thermosetting resin) are fed through the feeder 13 Both the mandrel drive motor 3 carriage drive motor 8 are electrically coupled for simultaneous as well as individual operations

The principle of operation of the invention

With reference to the Fig 2 of the accompanying drawings, the principle of operation of the invention is described below

Fibreglass roving soool 18 externaliy wound on a standard bobbins is mounted on two bearing supports 27 and the rotation of the spool 18 is controlled by means of tension control system 19 The rovings 1 under pre-set tension are passed through a resin wetting system The excess resin is squeezed out by means of two plastic rollers 16 The resin wet roving is then passed through a tension adjuster pulley 21 and a tension indicator 22 to the feeder 13 The mandrel drive motor 3 and the feeder drive unit are electrically coupled as generally described in fig 3 of the accompanying drawings for simultaneous operation of the system A total of twenty seven speeds ranging 0.47 m/min to 3.1 m/min for the feeder reciprocating system are achieved through a gear arrangement, so that twenty seven helix angles can be set for winding Winding tension during the process is monitored electrically and read on the indicator dial located on the control display panel 25 All the control circuitary (Fig 3) and the tension indicator equipment are located in the control box 24 Fumes, if any during the process are sucked out through an exhaust fume duct 23

Noteworthy features

1 The filament winding machine is useful for accurate fabrication of filament wound fibreglass tubular shells for chemical, electrical, agricultural and aeronautical and space industries It is an indigenous substitution of the equipment, and the associated know-how of filament winding techniques, using the invention for fabricating filament wound fibreglass reinforced plastics structures for chemical, electrical, agricultural, aeronautical and allied industries in India

The invention has been described with referance to a particular electromechanical system It is flexible in operation and has vast scope for modification and improvement

WE CLAIM

1 A filament winding machine for fabricating of filament-wound fibreglass reinforced plastic cylinders comprising a mandrel drive system and a feeder with feeder drive system with an adjustable roving feed head, separate means to drive the said mandrel drive system and feeder system, electrical circuit means for individually starting and stopping the said mandrel drive system and feeder drive system, a resin wetting system including an excess resin remover for wetting the fibreglass filaments, a precuring chamber, a pulley means to adjust the tension of the roving and an electrical tension measuring device to indicate the tension of the said roving wetted by the said wetting system

2 A filament winding machine as claimed in claim 1 wherein the said mandrel drive system comprises three phase electric motor, a reduction gear box and a mandrel mount

3 A filament winding machine as claimed in claim 1 or 2 wherein said feeder drive system comprises an electric motor, a lever operated gear box, a feeder carriage, a screw rod to facilitate feeder carriage reciprocating motor, limit switches, safety limits and a roving feeder arm

4 A filament winding machine as claimed in any of the preceding claims wherein said electrical circuit means is as shown in Fig 3 of the drawings, and an electrical coupling for simultaneously starting and stopping the two systems

5 A filament winding machine as claimed in any of the preceding claims wherein the said wetting system consists of a regulated feed of resin through a funnel on to the fibreglass roving during the winding process and a pulley and plastic squeezer rollers to secure uniform wetting of the resin, and control of resin content

6 A filament winding machine substantially as hereinbefore described with reference to the accompanying drawings.

Dated this 10th day of August, 1967

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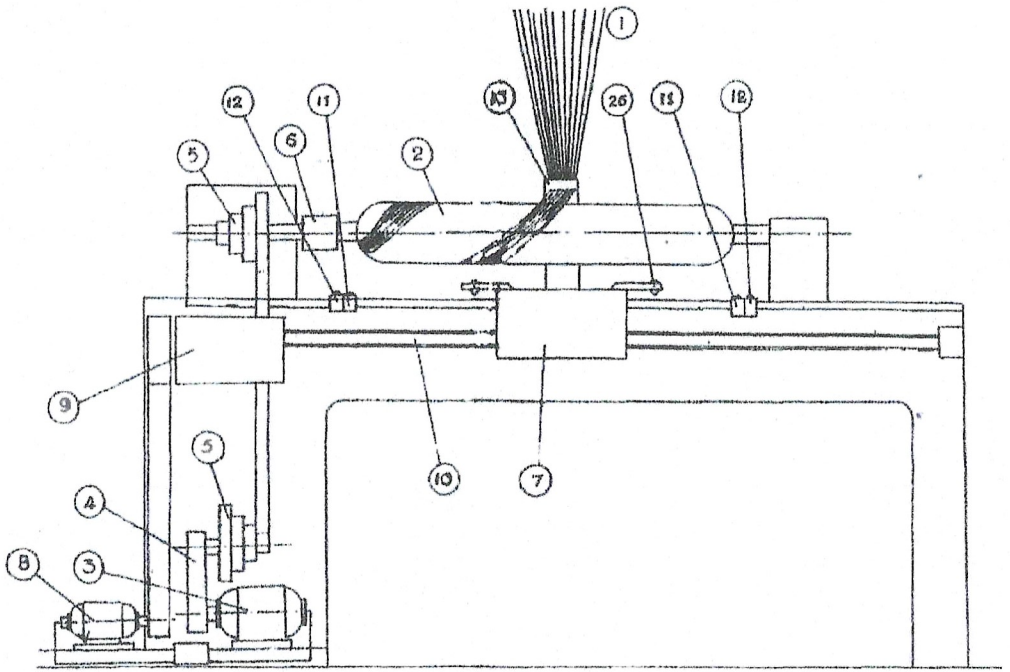


FIGURE (1)

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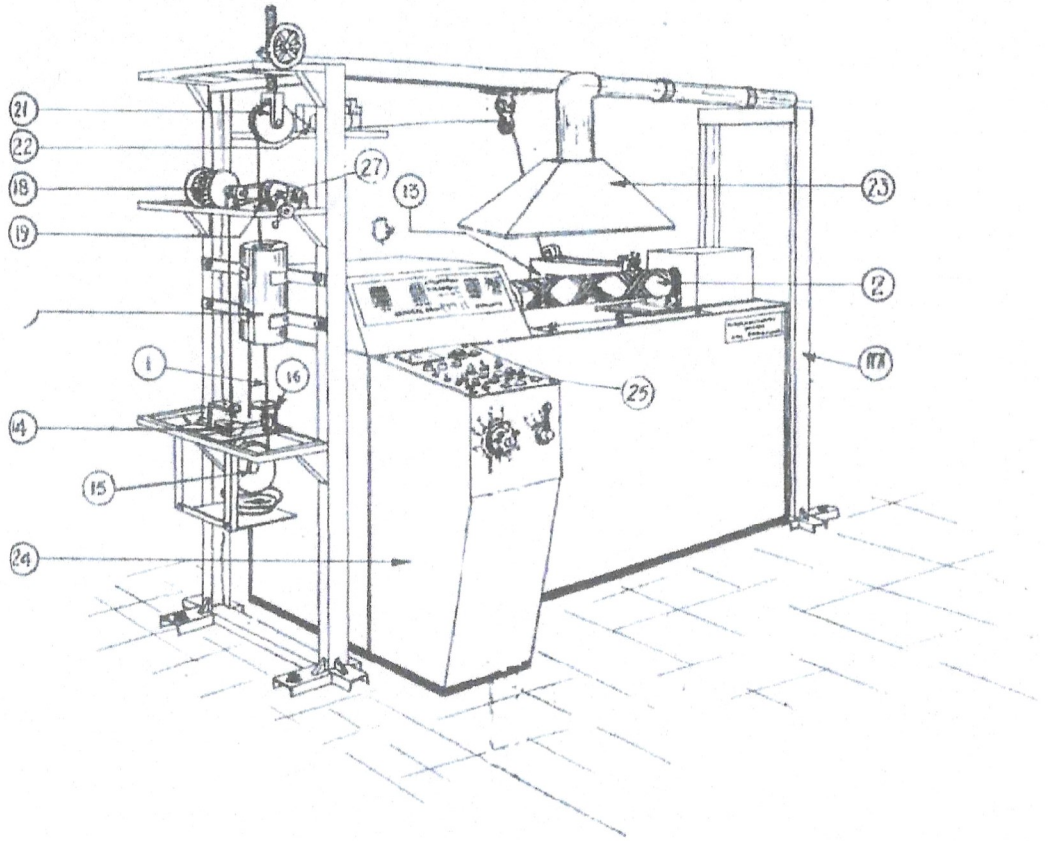


FIGURE. 2.

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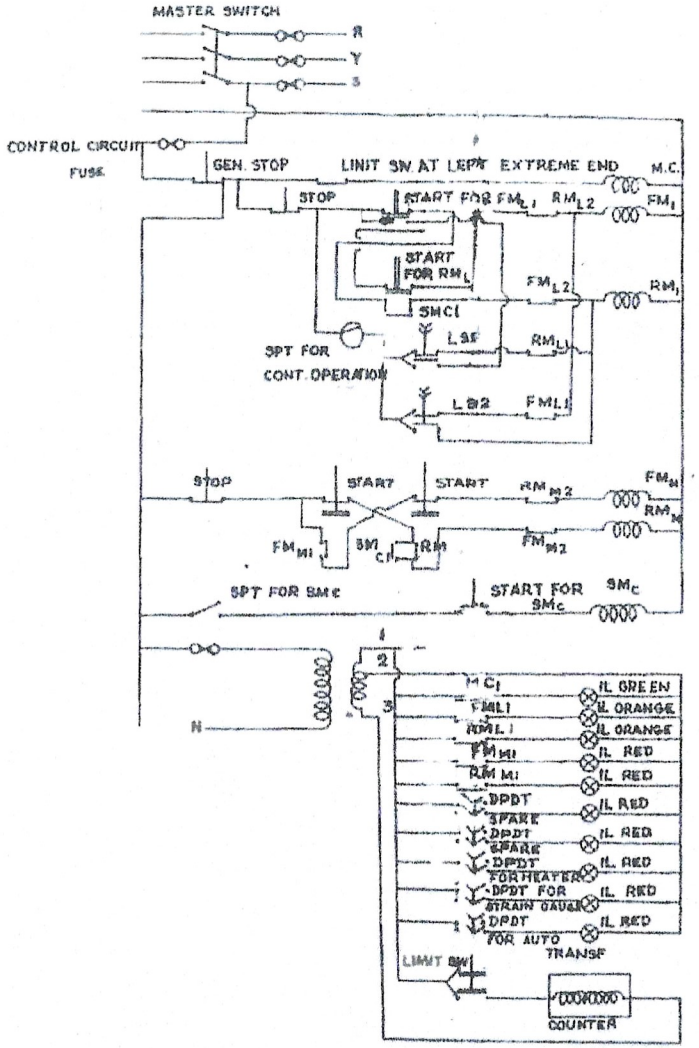


FIGURE 3

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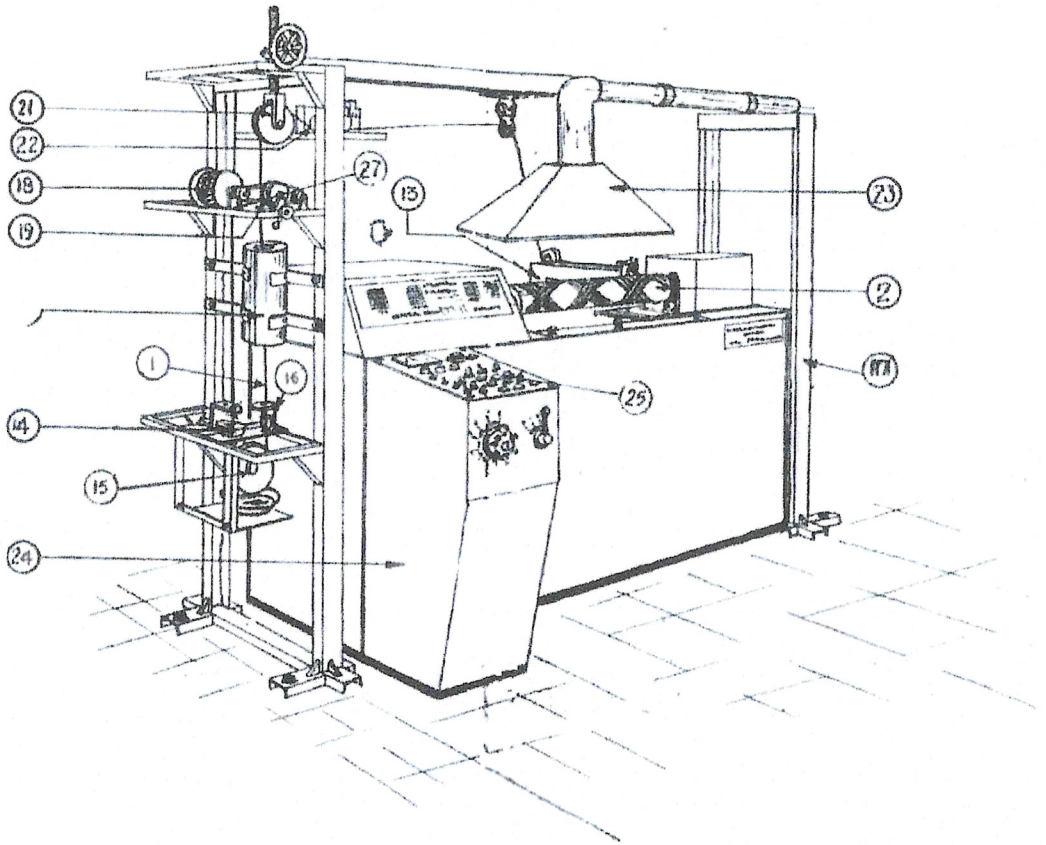


FIGURE 2.

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