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**International Classification—B65h17/06,25/02**

# PROVISIONAL SPECIFICATION

## "IMPROVEMENTS IN OR RELATING TO DRIVE ARRANGEMENTS FOR FOIL MATERIALS THROUGH CONTINUOUS PROCESSING EQUIPMENT WITH SPECIAL REFERENCE TO THE MAINTENANCE OF CONSTANT LINEAR SPEED."

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH, RAFI MARG, NEW DELHI-1, INDIA, AN INDIAN REGISTERED BODY INCORPORATED UNDER THE REGISTRATION OF SOCIETIES ACT (ACT XXI OF 1860).

*The following specification describes the nature of this invention :—*

This is an invention by BALKUNJE ANANTHA SHENOI, Scientist, RANGASWAMI RADHAKRISHNAN, Scientist, VENKATASUBRAMANIAN LAKSHMINARASIMHAN, Senior Scientific Assistant and KANDADAI RAJAGOPALACHARI NARASIMHAN, Scientist, employed in the Central Electrochemical Research Institute, Karaikudi-3, and all are Indian nationals.

This invention relates to improvements in or relating to drive arrangements for foil materials through continuous processing equipment with special reference to the maintenance of constant linear speed.

Hitherto it has been proposed to employ a chain drive for these drives. The chain goes over a number of sprockets mounted on rollers and also drives the take up/winding spool at the end of the process line. The continuous build-up of the processed foil on the take up/winding spool necessitates a corresponding continuous change in the angular velocity of the take up/winding spool, if the linear velocity of the foil through the processing line is to be kept constant. This requirement is at present met by the provision of friction pads or slipping clutches between the take up/winding spool and the sprocket connected to it.

This is open to the objection that the foil is subjected to tension.

The object of this invention is to obviate these disadvantages by isolating the drive for the take up/winding spool from the drive for all the other rollers.

The invention will be described with the help of accompanying drawing wherein the sole figure represents the working principle of the drive. The invention broadly consists in having — (i) a series of rollers which functions continuously by means of a chain drive or a gear drive, (ii) the foil 2 passing over the series of rollers 1, (iii) a separate drive motor 3 for the take up/winding spool 4 which functions intermittently; and (iv) a cradle roller 5 which forms a loop in the path of the foil actuates limit switches 6 to start and stop the drive motor mentioned at (iii) foregoing.

The following typical examples are given to illustrate the invention :

Example 1

This drive has been successfully used in the operation of continuously "etching" aluminium foil, required for the manufacture of electrolytic capacitors.

Example 2

This drive has been successfully used in the operation of continuously "forming" aluminium foil, required for the manufacture of electrolytic capacitors.

This drive can be used for continuously electroplating on (a) metal foils and (b) non-metallic foils.

This drive can be used for continuously anodising aluminium foils and aluminium alloy foils.

The following are among the main advantages of the invention : (i) The tension in the moving foil is much lower than in the other drive methods at present in use.

(ii) The constant speed of the foil is independently adjustable as there are no constraining forces transmitted back from the take up/winding spool as in the case of the other drives at present used.

(iii) Foils having very low tensile strength can be processed with this drive.

Dated this 8th day of December 1972.

Sd./-
(R. BHASKAR PAI)
*PATENTS OFFICER,*
*CSIR*

**Price : TWO RUPEES**

# COMPLETE SPECIFICATION

## "IMPROVEMENTS IN OR RELATING TO DRIVE ARRANGEMENTS FOR FOIL MATERIALS THROUGH CONTINUOUS PROCESSING EQUIPMENT WITH SPECIAL REFERENCE TO THE MAINTENANCE OF CONSTANT LINEAR SPEED"

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH, RAFI MARG, NEW DELHI-1, INDIA, AN INDIAN REGISTERED BODY INCORPORATED UNDER THE REGISTRATION OF SOCIETIES ACT (ACT XXI OF 1860).

*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 BALKUNJE ANANTHA SHENOI, Scientist, RANGASWAMI RADHAKRISHNAN, Scientist, VENKATASUBRAMANIAN LAKSHMINARASIMHAN, Senior Scientific Assistant and KANDADAI RAJAGOPALACHARI NARASIMHAN, Scientist, employed in the Central Electrochemical Research Institute, Karaikudi, and all are Indian nationals.

This invention relates to improvements in or relating to drive arrangements for foil materials through continuous processing equipment with special reference to the maintenance of constant linear speed.

In a continuous processing plant, the foil material is made to pass through a series of processing tanks by means of number of external and internal rollers. The foil material at the end of the process is wound over a winding spool. To make the foil to move into various processing tanks, the external rollers are provided with sprocket and free wheel at one end of the rollers. The rollers are rotated by means of a drive motor connected to these external rollers by means of chain which goes over the free wheel sprocket arrangement. The winding spool at the end of the process line is also connected similarly to drive motor. The continuous build-up of the processed foil material induces a corresponding continuous increase in linear velocity of the foil material. To maintain a fixed processing it is necessary to keep the linear velocity of the foil constant.

Hitherto it has been proposed to employ friction pads or slipping clutches between the winding spool and the sprocket-free wheel arrangement. By adjusting the friction over the friction pads by means of spring, the winding spool is made to revolve at lesser r.p.m. to compensate the increase in overall diameter of the wound foil. In this drive arrangement, the foil material is continuously wound on the winding spool.

This is open to objection that the foil material is subjected to excess tension while operating the plant. Due to the excess tension, the soft materials like paper, aluminium snap frequently and hence lead to breakdown of the plant. Periodic adjustment of friction over the friction pad has to be done manually. It leads to greater variation in characteristic values of the processed foil material. So, the foil material cannot be processed to close tolerance.

The main object of the invention is to keep constant linear speed of the foil material throughout the processing period. No adjustment for maintaining the linear speed of the foil material is necessary during operation. The tension in the moving foil is kept lower than in other drive mechanism.

According to the present invention, there is provided a device for maintaining constant speed of foil material through processing tanks comprising a chain drive which goes over sprockets mounted on rollers and a drive motor for driving the rollers through the chain characterised in that the said device comprises a cradle roller which is free to move up and down, a loop of the foil material formed by its going around the cradle roller, limit switches which are actuated by the movement of the cradle roller, a separate winding motor which is electrically connected to the limit switches and which is started and stopped automatically by the limit switches, and a winding spool which is driven by the winding motor whereby the said device results in constant speed of the foil material through the tanks irrespective of the foil accumulation on the winding spool, the said winding spool being driven intermittently and automatically by the winding motor.

The invention dispenses with the conventional arrangement of frictional or slipping clutches between the take-up spool/winding spool and the sprocket connected to it.

In this invention, a separate direct current motor is connected to all the external rollers in the continuous processing plant by means of a chain drive that goes over a sprocket-free-wheel set-up mounted at the end of each roller. By adjusting the impressed direct current voltage to the direct current motor, the external rollers can be rotated at any desired r.p.m. Hence, any required linear speed of the foil material can be maintained. The processed foil material is wound on a winding spool driven by a geared alternating current induction motor which is operated intermittently by means of two limit switches. When the alternating current induction motor is not in operation, excess unwound foil will be collected before the winding spool at the end of the process line. The excess foil is made to form a loop by means of a cradle roller which moves up and down freely during operation. As the loop enlarges, the cradle descends and actuates the lower limit switch to start the induction motor for winding the foil over the winding spool. As the loop contracts during winding, the cradle roller goes up and actuates the upper limit switch to stop the induction motor.

During operation, the direct current motor makes the foil to move continuously into various processing tank with a fixed linear speed. The alternating current induction motor intermittently winds the foil over the winding spool. The rate at which the foil is found at the winding spool is completely independent to the linear speed of the foil material. No periodic automatic or manual adjustment is required to maintain constant linear speed of the foil material. Any linear speed ranging between 5" and 120" per minute can be achieved by adjusting the impressed direct current voltage to the direct current drive motor. So long as the impressed direct current voltage remains fixed, the linear speed of the foil material remains constant.

By providing separate drives for take-up/winding spool and for all the other rollers of the continuous processing plant, necessary minimum tension is developed over the foil material during operating the plant. Therefore, soft materials like aluminium foil or paper can be processed without frequent breakdown of the plant.

The cradle roller is attached to an aluminium rod capable of moving up and down an aluminium tube rigidly fixed in the machine thereby forming a loop with the processed material and operating the limit switches of the winding motor, the limit switches being kept in the path of the cradle roller moving up and down.

The invention will now be described with the help of accompanying drawings wherein Fig. 1 is a diagrammatic view of the invented device.

The device (Fig. 1) is for maintaining constant speed of foil material 2 through processing tank 7. A chain drive 8 goes over sprockets 9 mounted on rollers 1. The

chain drive is driven by Motor 3A which runs at a pre-set constant speed.

An arrangement 10 is provided which has a cradle roller 5 which moves up when motor 3 works and which moves down when motor 3 stops and forms a loop 11 of foil material. Limit switches 6 and 6A are kept in the path of the cradle roller, and are operated by the cradle roller moving up and down. The limit switches 6 and 6A are electrically connected to the winding motor 3 which drives the winding spool 4 intermittently without disturbing the constant speed of the foil driven by the chain 8.

**Example 1**

(i) a series of long epoxy resin coated wooden or metal rollers are fixed to the structure of the plant by means of plummer block set up. The rollers are continuously driven by a drive motor by means of chain drive or gear drive.

(ii) the foil 2 is made to pass over the series of rollers 1.

(iii) a separate winding motor 3 is employed to intermittently operate the take-up/winding spool 4.

(iv) an epoxy resin coated wooden roller is attached to one end of an aluminium rod. A cylindrical tube is vertically fixed to the plant. The free end of the aluminium rod is pushed into the aluminium tube from the bottom so that the cradle set up will move up and down freely during operation. The limit switches 6 and 6A are fixed, one over the other in the path of the cradle. The limit switches are connected to the circuit of the winding motor 3. The foil is made to pass over the cradle roller 5. During operation, the cradle descends due to gravity and actuates the lower limit switch 6 to start the winding motor 3. The foil 2 is wound on the winding spool 4. During winding, the cradle roller 5 goes up and actuates the upper limit switch to stop the winding motor 3. The whole operation repeats automatically by itself during entire processing period and the linear spead of the foil material is kept constant.

**Example 2**

This drive has been successfully used in the operation of continuously "etching" aluminium foil, required for the manufacture of electrolytic capacitors. Aluminium foils upto 10" in width and in thicknesses ranging from 30 microns to 200 microns have been processed in the speed range of 5" to 120" per minute using standard alternating current induction motors with reduction gear as winding motor.

**Example 3**

This drive has been successfully used in the operation of continuously "forming" aluminium foil, required for the manufacture of electrolytic capacitors upto 10" in width and varying in thickness from 30 microns to 200 microns in the speed range of 5" to 120" per minute using standard alternating current induction motors with reduction gear as winding motor.

This drive can be used for continuously electroplating on (a) metal foils and (b) non-metallic foils.

This drive can be used for continuously anodising aluminium foils and aluminium alloy foils.

The following are among the main advantages of the invention :

(i) the tension in the moving foil is much lower than in the other drive methods at present in use.

(ii) the constant speed of the foil is independently adjustable as there are no constraining forces transmitted back from the take-up/winding spool as in the case of the other drives at present used.

(iii) foils having very low tensile strength can be processed with this drive.

If a single drive motor is used to drive both the plant rollers and the winding spool, due to build-up of the processed foil material, the linear speed of the foil increases continuously with processing time.

By using a separate drive motor for winding processed foil materials and operating the motor intermittently by means of a cradle roller limit switch arrangement, the linear speed of the foil is adjustable to any desired value. The linear speed is maintained constant throughout the processing period and no adjustment for maintaining the linear speed of the foil is necessary during operation. The tension in the moving foil is lower than in the other drive mechanisms. Therefore, foils with low tensile strength can be processed.

WE CLAIM :

1. A device for maintaining constant speed of foil material through processing tanks comprising a chain drive which goes over sprockets mounted on rollers, and a drive motor for driving the rollers through the chain characterised in that the said device comprises a cradle roller which is free to move up and down, a loop of the foil material formed by its going around the cradle roller, limit switches which are actuated by the movement of the cradle roller, a separate winding motor which is electrically connected to the limit switches and which is started and stopped automatically by the limit switches, and a winding spool which is driven by the winding motor whereby the said device results in constant speed of the foil material through the tanks irrespective of the foil accumulation on the winding spool the said winding spool being driven intermittently and automatically by the winding motor.

2. A device as claimed in claim 1 wherein the cradle roller is attached to an aluminium rod capable of moving up and down rigidly fixed aluminium tube thereby forming a loop with the processed material and operating the limit switches of the winding motor, the limit switches being kept in the path of the cradle roller moving up and down.

3. A device for maintaining constant speed of foil material through processing tanks substantially as hereinbefore described.

Dated this 2nd day of March 1974.

Sd./-

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*PATENTS OFFICER.*

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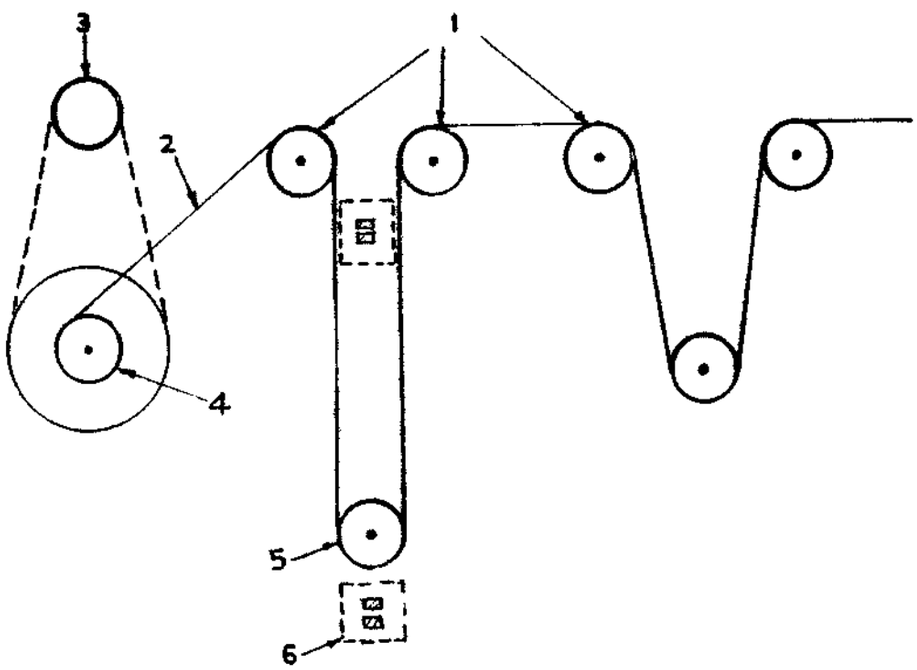


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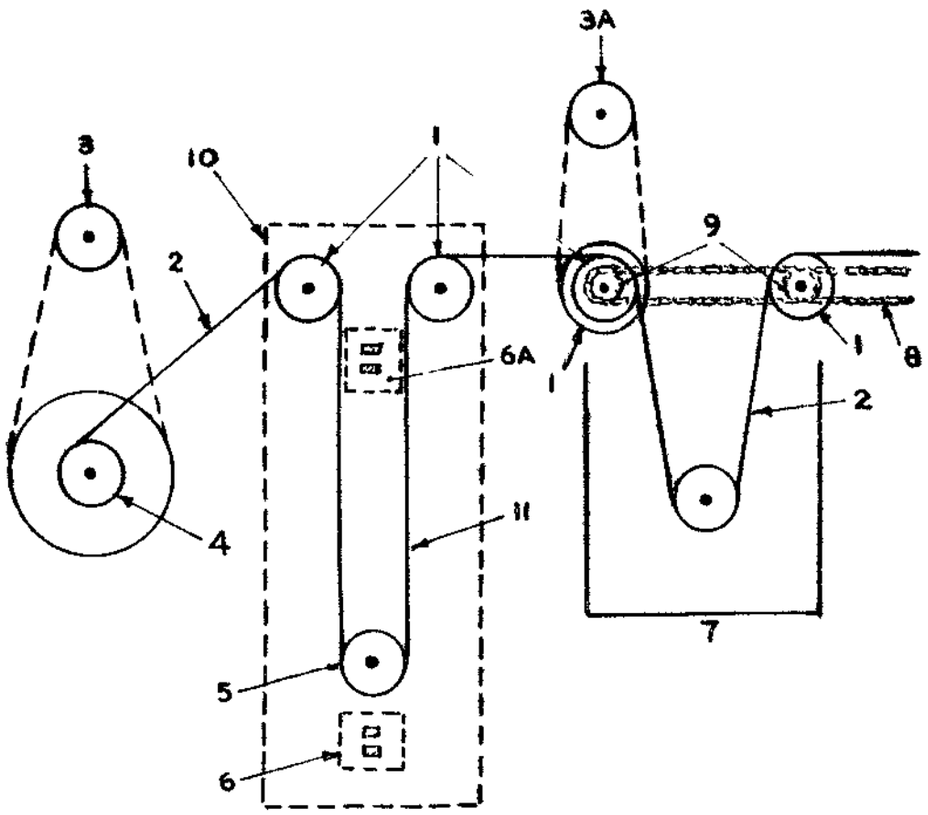


FIG. 1

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