

METHOD OF FEEDING CONTINUOUS STRIP, METHOD OF CONTROLLING THE
FEED, AND METHOD AND APPARATUS FOR MANUFACTURING TUBE OR
VESSEL HAVING OUTER FLANGE PORTION ON TUBULAR PORTION BY
USING THE FEED AND FEED CONTROL METHODS

Background of the Invention

FIELD OF THE INVENTION

The present invention relates to a method of feeding a continuous strip, which permits feeding a continuous strip having a fused front end to a welding portion of a work, a method of controlling the feed, which permits pushing and feeding the continuous strip to the welding portion of the work under a predetermined torque, and a method and an apparatus for manufacturing a tube or a vessel having an outer flange portion on a tubular portion by using the same feed and feed control methods.

DESCRIPTION OF THE RELATED ART

In the prior art, semiconductor wafers were heat treated by setting them in an airtight sealed reaction vessel, then subjecting them to heat treatment and then taking them out of the reaction vessel.

For this operation, the reaction vessel should be constructed such that its open end portion can be mounted on a mounting table airtight and detachably. Usually, the reaction vessel has an outer flange portion, which is mounted on the mounting table airtight and detachably.

For providing the open end portion of the reaction vessel with the outer flange portion, a doughnut-like member is formed by forming a plate material with a hole matching the inner diameter of the open end portion of the reaction vessel and cutting the plate material into the desired shape

of given dimensions.

This doughnut-like flange portion is welded to an open end of the said reaction vessel. The structure thus formed by welding is then machined to remove irregularities and obtain smooth inner and outer peripheral joint states.

In the above prior art technique, the preparation of the flange portion from a plate material results in a great amount of waste material in the cutting step. In addition, after the welding of the flange portion to the reaction vessel, the resultant structure should be machined to obtain smooth joint of the two parts.

Therefore, not only a great amount of material is necessary, but also a great extent of machining is necessary, leading to early consumption of tools and adding to the number of steps of processing. This is undesired from the economical standpoint.

A technique disclosed in Japanese Laid-Open Patent Publication No. 8-178169 is well known as a means for solving the above problems.

As shown in Fig. 12, the above technique comprises winding round a quartz glass strip 103 on an end portion of a transparent quartz glass tube 101 having a uniform cross section in the length direction, and then thermally welding the resultant structure with a first and a second burner 106 and 107.

In this technique, the quartz glass strip 103 is heated by the first burner 106 until it becomes soft enough so that it may be readily bent. In this state, the quartz strip 103 is wound on the quartz glass tube 101 while rotating the quartz glass tube 101 about the axis thereof. Concurrently, the inner surface of the quartz strip 103 being wound is heated by the second burner 107, thus causing melting of the

surfaces to be joined together. In this way, the quartz glass strip 103 is welded to the outer periphery of the quartz glass tube 101.

In this method, the welding is affected by the thickness of the quartz glass strip 103, burner temperature, rotational speed of the quartz glass tube 101 and so forth. Such a welding operation which is performed by manually controlling the burner temperature, the rotational speed and so forth, requires sophisticated skill.

Object and Summary of the Invention

In the light of the background discussed above, it is a first object of the present invention to provide a method and an apparatus for continuous strip feeding, which permits feeding a continuous strip having a fused front end to a welding portion of a work without need of sophisticated manual operation skill.

A second object of the present invention is to provide a method and an apparatus for continuous strip feeding control, which permits feeding a continuous strip having a fused front end to a welding portion of a work without need of sophisticated manual operation skill.

A third object of the present invention is to provide a method of and an apparatus for manufacturing a tube or a vessel having an outer flange portion on a tubular portion without need of sophisticated manual operation skill.

A fourth object of the present invention is to provide a method of and an apparatus for manufacturing a tube or a vessel having an outer flange portion on a tubular portion, which requires less material and is economical.

To attain the above first object, the present invention provides:

a first form in which the feeding of the continuous strip is controlled by controlling the feed rate thereof;

a second form in which the feeding of the continuous strip is controlled by permitting control of the feed rate of the continuous strip and the speed of movement of a fused portion of the continuous strip; and

a third form in which the feeding of the continuous strip is controlled by permitting control of either the feed rate of the continuous strip or the speed of movement of the fused portion.

In the second and third forms, even when the feed rate or the movement speed is outside a range of control, it can be adjusted by the other, and a broader scope of control is provided than the first form.

By the term "continuous strip" according to the present invention is meant not only a strip-like or like flat member but generally a member having an adequate length and a sectional profile such as to be capable of being fed continuously, such as a circular, oval, angular, etc. sectional profile.

The first form of the present invention features:

setting the continuous strip such that the end face thereof is in contact with the other periphery of the work;

thermally fusing an end portion of the continuous strip including the end face and welding the fused material to the work, while feeding the continuous strip toward the work;

moving the welding portion thereof toward the feed direction of the continuous strip;

detecting a displacement of the continuous strip in a direction perpendicular to the feed direction of the continuous strip during movement of the welding portion; and

controlling the rate of feed of the continuous strip

according to the detected displacement.

In the first form of the invention, as shown in Figs. 1 and 2, for instance, an end face 3a of a continuous strip 3 (i.e., quartz glass strip) is held in contact with the outer periphery of a tubular portion of a quartz glass tube 1, and an end portion of the continuous strip inclusive of the end face is thermally fused.

In this state, the continuous strip is fed to the direction in contact with the tubular portion while rotating the tubular portion toward the outer peripheral direction thereof.

When the rate of thermal fusing of the end of the continuous strip and the rate at which the fused material is received by the tubular portion of the quartz glass tube 1 are equal, that is, when the rotational speed of the tubular portion is matched to the thermal fusion rate, the quartz strip 3 is not displaced in directions (of arrows 40 and 41) perpendicular to the direction of feeding the continuous strip.

When the rotational speed of the tubular portion is excessive, the quartz glass strip 3 is pulled toward the tubular portion more than the thermal fusion rate of its end. As a result, the quartz glass strip 3 is raised by the viscosity of fused quartz glass, and is flexed and displaced in the direction of arrow 40.

When the rotational speed of the tubular portion is insufficient, the force with which to pull the quartz glass strip 3 is reduced, and the quartz glass strip 3 is displaced in the direction of arrow 41.

This displacement is detected, and the rate of feed of the continuous strip 3 is controlled to be in a predetermined range according to the detected displacement.

According to the present invention, it is effective to discontinue the feed of the continuous strip 3 by detecting a predetermined extent of feed of the continuous strip.

With the discontinuation of the feeding of the continuous strip by detecting a predetermined extent of feed of the continuous strip, the quartz glass tube 1 is continually rotating but the feeding of the quartz glass strip 3 is discontinued. The fused portion is, that is, cut apart from the rest of the strip 3. It is, thus, possible to cut off only with the discontinuation of the feeding of the continuous strip without providing the special cutting-off means.

The second form of the invention features:

setting the continuous strip such that the end face thereof is in contact with the outer periphery of the work;

thermally fusing an end portion of the continuous strip including the end face and welding the fused material to the work, while feeding the continuous strip toward the work;

moving the welding portion thereof toward the feed direction of the continuous strip;

detecting a displacement of the continuous strip in a detection perpendicular to the feed direction of the continuous strip during movement of the welding portion; and

controlling the rate of feed of the continuous strip and the speed of movement of the work according to the detected displacement.

The third form of the present invention features that either the rate of feed of the continuous strip or the speed of movement of the welding portion of the work is controlled according to the displacement noted above.

In the second and third forms of the present invention, it is possible to control either the rate of feed of the

continuous strip or the speed of movement of the welding portion of the work. This means that either one cannot be controlled, the other can be controlled. The scope of control is thus broadened, permitting readier control.

According to the present invention, it is effective to discontinue the feeding of the continuous strip by detecting a predetermined extent of feed of the continuous strip or a predetermined extent of movement of the work.

With this arrangement, the quartz glass tube 1 is continually rotating when the feeding of the quartz glass strip 3 is discontinued, so that the fused portion is cut apart from the rest of the strip 3.

According to the present invention, it is effective to pull back the continuous strip in the opposite direction to the feed direction when it is stopped.

With the arrangement that the continuous strip is pulled back in the direction opposite to the feed direction when it is stopped, as shown in Fig. 7, for instance, the torque of a gear 59 coupled to a motor 62 is transmitted to a rack 64a of continuous strip feed means 64 in the state that the quartz glass strip 3 is held clamped from the both width direction sides by pair clamp means 61 disposed on the both width direction sides of the quartz glass strip 3 on the continuous strip feed means 64. As a result, the continuous strip feed means 64 is moved in the direction of arrow. It is thus possible to obtain ready cutting-off of the quartz glass strip 3 and eliminate excessive fusion thereof.

To attain the above second object, the fourth form of the present invention features:

setting the continuous strip such that the end face thereof is in contact with the outer periphery of the work, and thermally fusing a front end portion of the continuous

strip including the end face and welding the fused material to the work, while feeding the continuous strip toward the work with a predetermined torque.

In the fourth form of the invention, as shown in Figs. 1 and 2, the continuous strip (for instance quartz glass strip) 3 is set with its end face 3a in contact with the outer periphery of the quartz glass tube 1, and a front end portion of the strip 3 including the end face is heated and fused.

If the force with which to push the continuous strip toward the work is insufficient, the fused portion of the continuous strip is not sufficiently pushed against the welding portion of the work. Therefore, a fused portion under an insufficient inner pressure and containing bubbles is welded.

If the above force is excessive, on the other hand, the fused end portion of the continuous strip is excessively pushed and partly flows in the width directions of the continuous strip. Therefore, the fused material is welded on the outer periphery of the work for more than the necessary width, resulting in an increase of the material to be mechanically removed after the welding. In addition, the continuous strip is welded thinly in correspondence to the amount of material that flew in the width directions, and it is no longer possible to obtain the necessary thickness.

According to the present invention, the continuous strip is fed with a predetermined torque transmitted thereto. The outer periphery of the work may not be truly circular, but may have greater or less diameter portions with respect to a reference diameter circle with axis of rotation as the center. When the work outer periphery becomes closer to the fused end portion of the continuous strip than the reference

diameter circle, the continuous strip is pushed back via the fused portion thereof, thus increasing the feeding load on the continuous strip and reduce the feed rate thereof.

When the work periphery becomes remoter from the fused end portion of the continuous strip than the reference diameter circle, the feeding load on the continuous strip is increased to slightly increase the pushing force and increase the feed rate of the continuous strip.

By applying a predetermined pushing force to the continuous strip, the feed rate can be automatically controlled when the work outer periphery is not truly circular but have greater and less diameter portions.

With the feeding of the continuous strip toward the work with a predetermined torque, a layer having a predetermined thickness can be welded on the work, thus minimizing the amount of welded material that is removed by machining after the welding.

However, as described before, excessive reduction of the pushing force applied to the continuous strip results in a bubble-containing welded portion on the work. When the pushing force is excessively increased, on the other hand, a welded portion having a necessary thickness can no longer be obtained.

According to the present invention, it is thus effective to control the torque transmitted to the continuous strip to the predetermined torque by detecting variations of the transmitted torque.

Consequently, it is preferable to control to the predetermined torque by detecting the variations of torque transmitted to the continuous strip.

In the above way, control of the torque to the predetermined torque is obtainable when the transmitted

torque from the drive source is varied or when the torque transmitted to the continuous strip is varied due to frictional forces of other drive mechanisms.

According to the present invention, this is effectively attainable by the provision of torque detecting means for detecting variations of torque transmitted to the continuous strip, clutch means for controlling the output torque from a drive source, and clutch control means for controlling the output of the clutch means, thereby controlling the transmitted torque to the predetermined torque.

As shown in Figs. 1 and 8, for instance, a torque detecting means (torque sensor) 36, clutch means (electromagnetic clutch) 35 for controlling transmitted torque from a drive source (motor) 14 and a clutch control means (controller) 50 for controlling the output of the clutch means, are provided to control the torque to a predetermined value. It is thus possible to eliminate excessive reduction of the pushing force applied to the continuous strip, thus eliminating the possibility that the welding portion of the work contains bubbles. In addition, the applied force is not excessively increased, and satisfactory welding can be ensured.

The above forms of the invention may be used to manufacture a tube or a vessel having a flange portion formed on a tubular portion.

This can be realized by:

setting a continuous strip such that the end face thereof is in contact with the outer periphery of the tubular portion of the eventual tube or vessel;

heating and fusing a front end portion of the continuous strip including the end face;

rotating the tubular portion to the outer peripheral

direction therefore, while feeding the continuous strip toward the tubular portion in contact therewith by applying a predetermined torque to the continuous strip;

detecting a displacement of the continuous strip in a direction perpendicular to the feed direction to the continuous strip during rotation of the tubular portion; and

controlling the extent of rotation of the tubular portion according to the detected displacement.

For the manufacture of a tube or a vessel having flange portion on the outer periphery of a tubular portion, it is further effective to lap wind the continuous strip by causing a plurality of rotations of the tubular portion, and also to let the fusion position of the continuous strip fed toward the tubular portion be adjustable and movable according to the number of rotations of the tubular portion, that is, provide heating means such that the fusion position of the object of heating is adjustable.

As shown in Figs. 3 and 11, for instance, the quartz glass strip 3 can be lap wound on the quartz glass tube 1 by rotating the tube 1 a plurality of rotations with the strip 3 held in contact with the outer periphery of the tube 1

When the quartz glass strip 3 is wound by one turn, the outer diameter of the flange portion is increased in correspondence to the thickness of the strip. If the strip 3 is rotated continuously at the same speed, it is taken up on the flange portion outer periphery while its fusion is insufficient because of an increased peripheral speed of the flange portion. The strip 3 is thus pulled by the flange portion of the quartz glass tube 1, and is displaced in the direction of arrow 40 in Fig. 1.

By this displacement the rotational speed of the glass quartz tube 1 is reduced, and the peripheral speed of the

flange portion on which the quartz glass strip 3 is wound is thus controlled to be equal to that for the previous turn of winding.

In addition, by making to be controllable the fusion position of the continuous strip fed toward the tubular portion of the quartz glass tube 1 and moving the fusion position by the heating means according to the number of rotations of the tubular portion, the fused position of the end of the continuous strip provided by the heating means can be controlled to be fixed irrespective of the flange portion diameter increase.

By making the fusion position of the work to be controllable by the heating means, in addition to be able to lap wind the quartz glass strip 3 on the quartz glass tube 1 and form a flange portion having a desired width, it is thus possible, by moving the fusion position according to the number of rotations of the work held by work mounting/moving means, to obtain a fixed fusion position of the end of the continuous strip by the heating means irrespective of the flange portion diameter increase and form a satisfactory flange portion.

Brief Description of the Drawings

Fig. 1 is a schematic representing an embodiment of the apparatus for feeding a continuous strip according to the present invention;

Fig. 2 is a view for describing an initial operation of the embodiment;

Fig. 3 is a view for describing an operation of forming a flange portion by lap winding;

Fig. 4 is a plan view showing an essential portion of the mechanical part of the feeding apparatus;

Fig. 5 is a sectional view taken along line A-A in Fig. 4;

Fig. 6 is a schematic representing a different embodiment of the apparatus for feeding a continuous strip according to the present invention;

Fig. 7 is a sectional view showing an essential portion of the mechanical part of the different embodiment of the feed controlling apparatus;

Fig. 8 is schematic representing a further embodiment of the apparatus for feed controlling of a continuous strip according to the present invention;

Fig. 9 is a plan view showing an essential portion of the mechanical part of the further embodiment;

Fig. 10 is a sectional view taken along line A-A in Fig. 9;

Fig. 11 is a view for describing an operation of forming a flange portion by lap winding; and

Fig. 12 is a schematic perspective view showing a related art.

Detailed Description of the Preferred Embodiments

Preferred embodiments of the present invention will now be described in detail with reference to the drawings. It is to be construed that unless otherwise specified, the dimensions, materials, shapes relative positions, etc. of constitutional parts described in the embodiments are by no means limitative but are merely exemplary.

Fig. 1 is a schematic representation of an embodiment of the apparatus for feeding a continuous strip according to the present invention. Referring to the figure, a CPU 52, to which a RAM 53 and a ROM 54 with control programs stored therein are connected, is connected via an interface 51 to a

controller 50 for controlling various mechanisms.

The controller 50 starts drive control upon appearance of a start signal 55, and can receive a signal from a light-receiving section 11b of a sensor 11, which detects the position of the open end of quartz glass tube 1 in the direction perpendicular to the plane of Fig. 1, and also a signal from an encoder 19 which detects the rate of feed of a quartz glass strip 3.

A displacement detecting roller 26 is disposed in contact with the top of the quartz glass strip 3. A displacement of the roller 26 in either direction of arrow 40 or 41, is transmitted to an encoder 20, which includes a sector gear member 20a and a detection gear 20b, whereupon the encoder 20 transmits a signal to the controller 50.

Upon receipt of this signal, the controller 50 passes the signal to the CPU 52, and also it sends out an output upon receipt of a computation signal from the CPU 52.

Various mechanism parts which are driven by the output signal of the controller 50 will now be described.

A quartz glass tube drive controller (hereinafter referred to as drive controller) 9 includes:

- a quartz glass tube chucking unit 10 for chucking a work, i.e., the quartz glass tube 1 having an outer flange portion, with a chuck 8;

- a motor 12 having a control means 15 for causing advancement and retreat of the quartz glass tube 1 in the axial direction thereof;

- motor 13 having a control means 16 for controlling the speed of rotation of the quartz glass tube 1 toward the outer peripheral direction; and

- the sensor 11 noted above which has light receiving and light-emitting sections 11b and 11a for detecting the

position of the open end of the quartz glass tube 1 in the axial direction thereof.

The control means 15 of the motor 12 controls the motor 12 such that it starts the motor 12 in response to a start signal from the controller 50 and stops the motor 12 upon receipt of a stop signal from the controller 50 in response to a signal of light-receiving section 11b of the sensor 11.

The control means 16 of the motor 13 starts the motor 13 for rotating the quartz glass tube 1 in response to start signal from the controller 50.

The quartz glass strip 3 is disposed such that a section of it can be pushed against the outer periphery of an open end portion of the quartz glass tube 1 by an adequate force F.

More specifically, the quartz glass strip 3 initially has a wedge-like front end inclined downward, and its end face 3a having a sectional area of approximately 2 x 30 mm is pushed against the outer periphery of the quartz glass tube 1 by a force F of 300 to 400 g.

During operation, the sectional area of 10 x 30 mm is pushed against the outer periphery of the quartz glass tube 1 by the above force F.

Preferably, the force F is 350 g.

The quartz glass strip 3 rests on a feed extent detecting roller 21 for detecting the rate of feed of the quartz glass strip 3 in cooperation with a feed roller 22 and the encoder 19.

Position regulating roller pairs 28 and 29 each of pair rollers spaced apart a predetermined distance, are operated by air cylinders 32 and 33 to clamp from the both sides the quartz glass strip 3 for position regulation thereof.

In its position regulated state, the quartz glass strip

3 is held pushed from above by a push roller 23 by operating an air cylinder 34, whereby the state of feeding of the strip 3 by the feed roller 22 and the state of feed extent detection by the feed extent detecting roller 21 are ensured satisfactorily.

The controller 50 further transmits a signal to control means 17 to control the rotational speed of a feed motor 14. The motor 14 is rotated with a constant torque by providing the force F noted above.

An electromagnetic clutch 35 is disposed between the feed motor 14 and the feed roller 22 for feeding the quartz glass strip 3. The state of torque transmission to the feed roller 22 is controlled by the state of coupling of the clutch 35.

The clutch 35 is disposed between input and output for axial torque control, and the holding force of its clutch can be selected to select the coupling state, i.e., coupling degree, of the clutch through electromagnetic force control.

When stopping the quartz glass strip 3, the feed roller 22 and the feed motor 14 are de-coupled from each other by the clutch 35.

A brake 36 is provided on the feed extent detecting roller 21. The quartz glass strip 3 is stopped when the brake 36 is driven electrically in synchronism with the de-coupling of the clutch 35 by a signal from the controller 50.

Burner control means 18 is disposed between the displacement detecting roller 26 and the drive controller 9. The burner control means 18 has a first and a second burner 6 and 7, which can heat and fuse from above and below a fused position of the quartz glass strip 3 including the front end thereof.

The first and second burners 6 and 7 are rotatable about their axis 6a and 7a of rotation to move the fusion position in the direction of extension of the quartz glass strip 3.

The essential portion of the mechanical part of the feeding apparatus of the continuous strip will now be described with reference to Figs. 4 and 5. Fig. 4 is a plan view showing the essential portion of the mechanical part. Fig. 5 is a sectional view taken along line A-A in Fig. 4.

Referring to these figures, the quartz glass tube chucking unit 10 is mounted in the drive controller 9. The quartz glass tube 1 is chucked in a front chuck 8 in the chucking unit 10. The sensor 11 is disposed for detecting the position of the tube 1 in the axial direction thereof.

The quartz glass strip 3 rests on rollers 24 and 25, the feed roller 22 and the feed extent detecting roller 21, which are mounted on the mounting table 4, such that the side face 3b of the quartz glass strip 3 is aligned to the end face 1b of the quartz glass tube 1 and that its end face 3a is in contact with the outer periphery 1a of the tube 1.

A pair of retainer rollers 28a and 28b are provided such that they can be brought into contact with and away from the side faces 3c and 3b of the quartz glass strip 3 by an air cylinder 32. Another pair of retainer rollers 29a and 29b are provided such that they can be brought into contact with and away from the side faces of the strip 3 by an air cylinder 33.

A burner holder 5 supporting a first and a second burner 6 and 7 is supported on the mounting table 4 adjacent the drive controller 9. A burner control means 18 is provided in the burner holder 5.

The above construction will be described in further detail with reference to Fig. 5. The mounting table 4 is

mounted on a bed 67 supported by legs 68. The first and second burners 6 and 7 are supported on the burner holder 5 such that they are disposed above and below the quartz glass strip 3.

The first and second burners 6 and 7 are located such that they can heat and fuse a peripheral portion of the quartz glass strip 3 including the end face 3a thereof, and the both burners are rotatable about their axis 6a or 7a of rotation to be variable the fused position thereof.

The feed roller 22 is coupled for rotation via a belt 38 to one shaft of an electromagnetic clutch 35 provided underneath the mounting table 4, and the other rotational portion of the feed roller 22 is coupled to the feed motor 14 via clutch portion.

The feed extent detecting roller 21 is coupled via a belt 37 to the rotational shaft of a brake 36 provided underneath the mounting table 4. Under control of a signal from the controller 50, the rotational shaft is braked to stop the roller 21 and thus frictionally stop the quartz glass strip 3.

The encoder 19 which is coaxial with the detecting roller 21 detects the rotational speed thereof.

A mounting member 39 mounted on the top of the mounting table 4 supports an air cylinder 34 mounted at its top. On the air cylinder 34, a detecting arm support 42 is mounted, which is pushed down by a predetermined force when the air cylinder is operated. The detecting arm 42 supports a push roller 23, which pushes down from above a portion of the quartz glass strip 3 intermediate between the feed roller 22 and the feed extent detecting roller 21 and thus stabilizes the state of contact of these rollers with the strip 3.

The detecting arm support 42 also supports a detecting

arm 27, which carries at an end a detecting roller 26 in contact with the top of the quartz glass strip 3 for detecting a displacement thereof, and an encoder 20 for detecting the extent of movement of the detecting arm 27.

The operation of the embodiment having the above construction will now be described.

For operation, various parameters are provided to the controller 50 from an input unit (not shown).

Such parameters are the diameter and wall thickness of the quartz glass tube 1 as work, the thickness and width of the quartz glass strip 3, the initial control pulse cycle of the motor 13 for rotating the tube 1, the initial control pulse cycle of the feed motor 14 for feeding the strip 3, the initial value of the clutch 35 disposed between the feed motor 14 and the feed roller 22 and for controlling the transmitted torque and so forth.

From these data, the CPU 52 calculates the necessary rotations of the quartz glass tube 1, the necessary extent of feed of the quartz glass strip 3 and so forth, and determines the extent and timing of movement of continuous strip mounting/feeding means 64, drive timing of clamping means 61 and so forth.

Referring to Fig. 2, when the quartz glass tube 1 is chucked in the chuck 8 of the quartz glass tube chucking unit 10, its open end face is at position 1b'.

The end face of the quartz glass strip 3 set on the various rollers is set at predetermined position 3a'.

When start signal 55 is generated by depressing a control panel switch (not shown), the controller 50 receiving this signal sends out a start signal to the control means 15 of the motor 12 (Fig. 1).

In response to this start signal, the motor 12 is

started to move the quartz glass tube chucking unit 10 in the direction of arrow 43 in Fig. 2.

When the end face 1b of the quartz glass tube 1 reaches the position shown by the solid line, the light-receiving section 11b of the sensor 11 sends out a signal to the controller 50 to stop the quartz glass tube chucking unit 10 at that position.

In synchronism to the above start signal, the controller 50 drives the air cylinders 32 and 33 to bring the position regulating roller pairs 28a, 28b and 29a, 29b into contact with the sides 3c and 3b of the quartz glass tube 3 for position regulation thereof into alignment with the end face 1b of the quartz glass tube 1.

The controller 50 then drives the cylinder 34 to apply a predetermined force to a push roller 23 and also to an detecting arm support 42 supporting the encoder 19 mounted thereon.

The controller 50 then supplies a signal to the clutch 35 to cause coupling thereof, causes the control means 17 to start the feed motor 14 to so as to cause the feed roller 22 to feed the quartz glass strip 3, and causes the encoder 19 to measure the feed.

When the quartz glass strip 3 is fed to a predetermined extent from the predetermined position 3a' in Fig. 2, the controller 50 brings the clutch 35 to a half-clutch state. As a result, the strip 3 is stopped with its end face 3a in contact with the outer periphery of the quartz glass tube 1.

In synchronism with the stopping of the quartz glass strip 3, the first and second burners 6 and 7 are caused to start heating and fusing of an end portion of the strip 3 including the end face 3a thereof.

When the outer periphery of the quartz glass tube 1 and

the end portion of the quartz glass strip 3 including the end face 3a are fused, the two are welded together. In synchronism to this welding, the motor 13 is rotated to cause rotation of the quartz glass tube 1 in the counterclockwise direction in Fig. 1.

When the quartz glass tube 1 completes one rotation, a flange portion is formed on its outer periphery. Before completion of one rotation of the tube 1, the brake 36 is driven, and also the clutch 35 is de-coupled. As a result, the quartz glass strip 3 is stopped, while the tube 1 is rotating. The strip 3 is thus automatically cut apart from its fused portion.

Then, the heating operation of the two burners is stopped.

Preferably, the quartz glass tube 1 is rotated with a slight time lag with respect to the timing of the heating by the both burners so that the rotation is synchronized to an adequate fused state. Also, the feed of quartz glass strip 3 is preferably stopped slightly before completion of one rotation of the tube 1, so that the end face of the quartz glass strip 3 welded to the outer periphery of the tube 1 coincides with the fused portion which is cut apart.

The extent of rotation of the quartz glass tube 1 is calculated from known data such as the outer diameter and the rotational speed of the tube 1, the thickness of the quartz glass strip 3 and so forth. However, it is possible to calculate the rotation extent from data obtained by detecting the feed extent with the feed extent detecting roller 21 and the encoder 19.

The cut position of the quartz glass strip 3 is thus controlled by the extent of feed of the quartz glass strip 3 or the extent of rotation of the quartz glass tube 1 or the

like.

During the above welding operation, the rate of feed of the quartz glass strip 3 is controlled by the control means 17. More specifically, the encoder 20 detects a displacement (in the direction of arrow 40 or 41) of the displacement detecting roller 26 in contact with the top of the quartz glass strip 3, and transmits detected displacement data to the control means 17. According to this data, the control means 17 controls the speed of the motor 14.

Specifically, the quartz glass strip 3 is fed toward the tubular portion of the quartz glass tube 1 while rotating the tubular portion toward the outer peripheral direction thereof. When the amount of thermally fused material is equal to the amount of material fusedly taken up on the tubular portion each other, the quartz glass strip 3 is displaced in neither direction (of arrow 40 or 41) perpendicular to the direction of feed of the continuous strip.

When the rotational speed of the quartz glass tube 1 is excessive compared to the rate of welding of material to the tube 1, the quartz glass strip 3 is pulled by the tube 1, so that it is flexed and displaced in the direction of arrow 40.

When the rotational speed of the quartz glass tube 1 is insufficient, the rate of fusion is excessive, and the force with which to pull the solid part of the quartz glass strip 3 is reduced. As a result, the strip 3 is displaced in the direction of arrow 41.

The above displacement is detected, and the rotational speed of the quartz glass strip 3 is controlled to be in a predetermined range according to the detected displacement.

As described before, the quartz glass strip 3 can be automatically cut apart by stopping it. To this end, the

both burners may be constructed such that the fusion position of the work can be controlled at this time.

Specifically, the heating means is moved away from the quartz glass tube 1 in a synchronism to the stopping of the quartz glass strip 3 after the strip 3 has been fed to a predetermined extent. By so doing, the strip 3 can be cut apart with its end face at a position sufficiently spaced apart from the outer periphery of the flange portion that has been formed.

With this arrangement, it is not possible that the heating operation of the heating means is stopped at a delayed timing to cause fusion of the end face of the quartz glass strip and cause the fused material to be attached to and contaminate the outer periphery of the flanged portion.

An operation of forming a flange portion by lap winding the quartz glass strip 3 on the quartz glass tube 1, will now be described with reference to Fig. 3.

The quartz glass strip 3 can be lap wound on the quartz glass tube 1 by rotating the tube a plurality of rotations with the end face 3a of the strip 3 in contact with the outer periphery of the tube 1.

When a flange portion 2a is formed by winding the quartz glass strip 3 by one turn by causing one rotation of the quartz glass tube 1, the outer diameter of the overall flange portion is increased by an amount corresponding to the thickness 2a of the strip 3.

With a consequent increase of peripheral speed of the quartz glass tube 1, the quartz glass strip 3 is pulled by the tube 1 and flexed upward. The encoder 20 may detect the flexing and reduce the peripheral speed of the flange portion 2a according to the detected flexing, thus making the amount of thermally fused material of the strip 3 and the amount of

material fusedly taken up on the tube 1 equal to each other.

When the quartz glass strip 3 is wound by another turn, a flange portion 2b is formed. Now, a further flange portion 2c is formed by reducing the peripheral speed of the flange portion 2b to be equal to that in the previous winding.

With increasing layers 2b, 2c, ... of the overall flange portion formed on the quartz glass tube 1, the diameter of the flange portion is increased. With this diameter increase, the position at which the quartz glass strip 3 is to be thermally fused, is moved to the right in Fig. 3. This thermally fusion position is followed by changes in the spout angles of the first and second burners 6 and 7 to 70A, 71A, ..., and 70B, 71B,

As shown above, the peripheral speed of the flange portion of the quartz glass tube 1, on which the quartz glass strip 3 is wound, is held constant by controlling the rotational speed of the tubular portion according to the diameter increase of the flange portion. It is thus not possible that the strip 3 is wound on the flange portion outer periphery with insufficient elongation or contraction of it due to peripheral speed increase of the flange portion.

During the above welding operation, the rotational speed of the quartz glass tube 1 is controlled by the control means 16.

More specifically, the encoder 20 detects a displacement (of arrow 40 or 41) of the displacement detecting roller 26 in contact with the top of the quartz glass strip 3, and transmits detected displacement data to the control means 16. According to this data, the control means 16 controls the speed of the motor 13.

It will be seen that even when either the speed rate of feed of the continuous strip or the speed of movement of the

fused portion cannot be controlled, the other can be controlled. The scope of control is thus broadened, permitting readier control.

Particularly, when lap winding the quartz glass strip 3, the rotational speed of the quartz glass tube 1 should be reduced continuously in a short period of time, during which the second turn is wound in a step-like fashion on a leading end portion of the first turn. In this embodiment, during this short period of time the speed of the tube 1 is reduced to one for the second turn. In addition, the rate of feed of the quartz strip 3 can be reduced by the clutch 35, the control means 17 and so forth.

As described above, in this embodiment a continuous strip is welded to a work by holding its end face in contact with the outer periphery of the work and thermally fusing its front end portion including the above end face.

The continuous strip is fed toward the work to move the welding portion in the direction of feed of the continuous strip.

During movement of the welding portion relative to the work, any displacement of the continuous strip in a direction perpendicular to the feed direction is detected, and the rate of feed of the continuous strip is controlled according to the detected displacement.

It is thus possible to form a flange portion in a constant fused state, i.e., in a constant form, on a tubular portion of the work irrespective of changes in the burner heat amount or burner shape in the heating means. That is, it is possible to form a flange portion on the outer periphery of tubular portion with less material and processing, and thus economically, without need of sophisticated manual operation skill.

Furthermore, it is possible to control both the rate of feed of the continuous strip and the speed of movement of the work. By incorporating these controls for controlling the feed of the continuous strip, when either the rate of feed or the speed of movement gets out of a control range, this can be made up for by the other control. It is thus possible to obtain efficient control.

In this embodiment, the quartz glass tube and the quartz glass strip are welded together by thermally fusing them. However, this is by no means limitative; it is possible to weld together members of other glasses or metals as well so long as the welded materials have the same melting temperature.

Fig. 6 is a schematic representation of a different embodiment of the apparatus for feeding a continuous strip according to the present invention.

This embodiment is different from the preceding embodiment Fig. 1 in that, in lieu of the mounting table 4 secured to the bed 67 (Fig. 5), a continuous strip mounting/feeding means 64 (Fig. 7) is slidably provided on the bed 67, and the angles of the burners 6 and 7 are fixed.

Also, in lieu of the brake 36 (Fig. 5), a clamping means 61 (Fig. 7) is provided for clamping the quartz glass strip 3 from the width sides thereof. When lap winding the strip 3, the fusion position can be adjusted by causing a retreat of the mounting/feeding means 64. After the welding is over, the strip 3 can be clamped with the clamping means 61, and the mounting/feeding means 64 can be further retreated, thus cutting-off the strip 3.

The controller 50 calculates the extent of rotation of the quartz glass tube 1 or the extent of feed of the quartz glass strip 3, and send out the calculation data to the

clamping means 61.

The continuous strip mounting/feeding means 64 has a rack 64a which is in mesh with a drive gear 59 of gear control means 60 including a motor. The controller 50 can also send out the calculated data of the extent of rotation of the quartz glass tube 1 or the extent of feed of the quartz glass strip 3 to the gear control means 60.

The construction of this embodiment will now be described in greater details with reference to Fig. 7.

Referring to Fig. 7, a mounting table 27 secured by legs 68 to the floor (not shown), supports a rail (not shown) secured to it and extending in the continuous strip feed direction. The continuous strip mounting/feeding means 64 is slidably mounted on the rail.

The mounting table 67 has a central elongate opening 67a, through which the motor 14 and the clutch 35 are mounted on the continuous strip mounting/feeding means 64.

A burner holder 5 is secured to the continuous strip mounting/feeding means 64, and a first and a second burner 6 and 7 are secured to the burner holder 5.

A pair of clamping means 61 are disposed on both sides behind the roller 25 such that they can clamp the quartz glass strip 3 from the width sides. The clamping means 61 have clamp members 61a with clamping faces thereof constituted by rubber or like high friction coefficient material. The clamping members 61 can be moved between an advanced position in forced contact with the opposite sides of the quartz glass strip 3 and a retreated position spaced apart therefrom according to command signals from the controller 50.

The continuous strip mounting/feeding means 64 is slidable with its rack 64a provided on one side of it in mesh

with the gear 59 secured to the drive shaft of the motor 62.

The operation of this feeding apparatus will now be described.

The controller 50 supplies a signal to the gear control means 60 to drive the motor 62 so as to move the continuous strip mounting/feeding means 64 forward, i.e., to the left, via the gear 59 and the rack 64a, thus setting the first and second burners 6 and 7 at a predetermined position.

The subsequent welding operation is the same as described before in connection with Fig. 1. When a predetermined extent of rotation of the quartz glass tube 1 or feed of the quartz glass strip 3 is reached, the motor 62 is driven reversely to cause retreat of the continuous strip mounting/feeding means 64 to the right for welding position adjustment of the heating means before lap winding of the quartz glass strip 3.

When the quartz glass strip 3 has been fed to a predetermined extent, the clamping members 61a of the clamping means 61 are caused to clamp the opposite sides of the strip 3, and the motor 62 is further retreated to the right side reversely. The strip 3 is thus moved to the right and cut off.

In synchronism to the operation of the clamping means 61, the motor 14 is stopped, and the clutch 35 is de-coupled. Even if the stopping of the motor and the de-coupling of the clutch are delayed, the quartz glass strip 3 can be cut off without delay and reliably, so long as the speed of retreat of the continuous strip mounting/feeding means 64 is set to be higher than the rate of feed of the strip 3.

After the quartz glass strip 3 has been cut off, the operation of the first and second burners 6 and 7 is discontinued. In synchronism to this, the continuous strip

mounting/feeding means 64 is moved forward to the left to restore the two burners to the initial position.

In this embodiment the feeding of the quartz glass strip 3 is controlled by calculating the extent of rotation of the quartz glass tube 1. Alternatively, it is possible to detect the extent of feed of the quartz glass strip 3 corresponding to the extent of rotation of the quartz glass tube 1, and stop the rotation of the tube 1 or the feeding of the strip 3 according to the detected feed extent.

As shown above, the continuous strip is adapted to be pulled back in the direction opposite to the feed direction. It is thus possible to obtain readier cutting-off of the quartz glass strip and eliminate excessive fusion thereof.

Fig. 8 is a schematic representation of a further embodiment of the apparatus for feeding a continuous strip according to the present invention.

This embodiment is different from the previous embodiments in that:

torque transmitted via the clutch 35 and the roller 22 to the quartz glass strip 3, is detected by a torque sensor 36 via a detecting roller 21 and a belt 37, and the controller 50 receives a detection signal from the torque sensor 36;

in lieu of the mounting table 4 secured to the bed 67 (Fig. 5), continuous strip mounting/feeding means 64 (Fig. 10) is slidably provided on the bed 67, and the angles of the burners 6 and 7 are fixed;

a pair of clamping means 61 (Fig. 10) are provided for clamping the quartz glass strip 3 from the width sides, the fusion position being adjustable by causing a retreat of the continuous strip mounting/feeding means 64 when lap winding the strip 3, and the continuous strip mounting/feeding means

64 is adapted to be further retreated with the strip 3 held clamped by the clamping means 61 for cutting-off the strip 3 after completion of the welding; and

the continuous strip mounting/feeding means 64 which includes a rack 64a, is disposed rearwardly of, i.e., on the right side of the drive controller 9 such that it is slidable via a gear 59 controlled by control means 60 including a motor.

The continuous strip mounting/feeding means 64 is adapted such that by driving an air cylinder 34 the quartz glass strip 3 is pressed down on it from above by the push roller 23, thus ensuring the feeding of the quartz glass strip 3 by the feed roller 22 and the detection by the detecting roller 21 to be satisfactory.

The controller 50 transmits a signal to the control means 17 to control the rotational speed of the motor 14, and also transmits a signal to a clutch 35 to be described later to provide a pushing force F and cause rotation of the motor 14 with a constant torque.

An electromagnetic clutch 35 is disposed between the feed motor 14 and the feed roller 22 for feeding the quartz glass strip 3, and the state of torque transmission to the feed roller 22 is controllable by the clutch coupling state.

The electromagnetic clutch 35 is disposed for axial torque control between input and output, and by magnetic force control it is possible to select the holding force of the clutch member, i.e., select the coupling state of coupling extent of the clutch.

When discontinuing the feed of the quartz glass strip 3, the clutch 35 de-couples the feed roller 22 and the feed motor 14 from each other.

The operation of this embodiment will now be described

with reference to Figs. 9 and 10.

Fig. 9 is a plan view showing an essential portion of the mechanical part of the embodiment. Fig. 10 is a sectional view taken along line A-A in Fig. 9. Fig. 10 is the same as Fig. 7 except for that the detecting roller 21 is shown coupled to the torque sensor 36 via a belt 37.

The operation of this embodiment having the above construction will now be described.

The heating and fusing of a portion of the quartz glass strip 3 in the neighborhood of the end face 3a thereof by the first and second burners 6 and 7, is started with the end face 3a in contact with the outer periphery of the quartz glass tube 1.

In synchronism to this heating operation, the controller 50 supplies a signal to the clutch 35 for coupling thereof with a predetermined torque M, as well as causing the control means 17 to start the motor 14 and let the quartz glass strip 3 be fed by the feed roller 22, and causes the encoder 19 to measure the feed extent afresh.

When the pertinent portion of the outer periphery of the quartz glass tube 1 and a front end portion of the quartz glass strip 3 including the end face 3a have been fused together, the two portions are welded together. In synchronism to this welding, the motor 13 is driven to cause rotation of the tube 1 in the counterclockwise direction in Fig. 8.

The front end portion of the quartz glass strip 3 including the end face is thermally fused by pushing the end face 3a with predetermined torque against the pertinent tubular portion outer periphery of the quartz glass tube 1.

When one rotation of the quartz glass tube 1 has been completed, a flange portion is formed thereon. Before

completion of one rotation of the tube 1, the clutch 35 is de-coupled, the motor 14 is stopped, and the clamping means 61 is operated to let the quartz glass strip 3 be clamped from the width sides. The feeding of the strip 3 is thus stopped.

In this state, the quartz glass tube 1 is continually rotated, and the quartz glass strip 3 is automatically cut apart from the fused portion.

The heating operation of the both burners is then discontinued.

During the above welding operation, the torque transmitted to the quartz glass strip 3 is controlled by the clutch 35. More specifically, the detecting roller 21 in contact with the underside of the strip 3 detects the torque received by the strip 3 from the feed roller 22, and transmits detected torque data to the controller 50, whereby the coupling state of the clutch 35 is controlled to conjugate the transmitted torque.

While the quartz glass strip 3 can be automatically cut off by stopping the feeding of the strip 3, it is possible to construct the two burners such that the fused portion of the work is adjustable.

The continuous strip mounting/feeding means 64 can be moved together with the burner holder 5 to the right in Fig. 10 by driving the motor 62.

The quartz glass strip 3 can be cut off such that its end face is at a position sufficiently spaced apart from the outer periphery of the flange portion that has been formed by moving the heating means away from the quartz glass tube 1 in synchronism to the stopping of the strip 3 after the strip 3 has been fed to a predetermined extent.

Thus, it is not possible that a lag of the

discontinuation of the heating of the heating means causes prolonged fusion of the end face of the quartz glass strip 3 to cause attachment of the fused material to the flange portion and contamination of the outer periphery of the flange portion.

Now, the operation of forming a flange portion by lap winding the quartz glass strip 3 on the outer periphery of the quartz glass tube 1, will be described with reference to Fig. 11.

The quartz glass strip 3 can be lap wound on the quartz glass tube 1 by causing a plurality of rotations of the tube 1 with its end face 3a held in contact with the outer periphery of the tube 1.

When a flange portion 2a is formed by winding quartz glass strip 3 by one turn by causing one rotation of the quartz glass tube 1, the outer diameter of the overall flange portion is increased by an amount corresponding to the thickness 2a of the strip 3.

With a consequent increase of outer peripheral speed of the quartz glass tube 1, the quartz glass strip 3 is pulled by the tube 1 and flexed upward. The encoder 20 may detect the flexing and reduce the peripheral speed of the flange portion 2a according to the detected flexing, thus making the amount of thermally fused material of the strip 3 and the amount of material fusedly taken up on the tube 1 equal to each other.

When the quartz glass strip 3 is wound by another turn, a flange portion 2b is formed. Now, a further turn, a flange portion 2c is formed. Now, a further flange portion 2c is formed by reducing the peripheral speed of the flange portion 2b to be equal to that in the previous winding.,

With increasing layers 2b, 2c, ... of the overall flange

portion formed on the quartz glass tube 1, the diameter of the flange portion is increased. With this diameter increase, the position at which the quartz glass strip 3 is thermally fused, is moved to the right in Fig. 11. This thermally fusion position is followed by changes in the spout angles of the first and second burners 6 to 7 to 70A, 71A, ..., and 70B, 71B, ...

As shown above, the peripheral speed of the flange portion of the quartz glass tube 1, on which the quartz glass strip 3 is wound, is held constant by controlling the rotational speed of the tubular portion according to the diameter increase of the flange portion. It is thus not possible that the strip 3 is wound on the flange portion outer periphery with insufficient elongation or construction of it due to peripheral speed increase of the flange portion.

During the above welding operation, the rotational speed of the quartz glass tube 1 is controlled by the control means 16.

More specifically, the encoder 20 detects a displacement (or arrow 40 or 41) of the displacement detecting roller 26 in contact with the top of the quartz glass strip 3, and transmits detected displacement data to the control means 16 via controller 50. According to this data, the control means 16 controls the rotational speed of the quartz glass tube 1 through the motor 13.

Particularly, when lap winding the quartz glass strip 3, the rotational speed of the quartz glass tube 1 should be reduced continuously in a short period of time during which the second turn is wound in a step-like fashion on a reading end portion of the first turn. In this embodiment, during this short period of time the speed of the tube is reduced to

one for the second turn. In addition, the rate of feed of the strip 3 per unit time can be controlled and reduced by the clutch 35.

As has been shown, in this embodiment with the end face of the continuous strip held in contact with the outer periphery of the work, a front end portion of the continuous strip including the end face is heated and fused to weld the fused portion on the work, while feeding the continuous strip toward the work with a predetermined torque.

The torque transmitted to the continuous strip in this embodiment according to the invention is controlled to the predetermined torque by detecting variations of the transmitted torque. It is thus possible to control the transmitted torque to the predetermined torque when the torque transmitted from the drive source is varied or even when torque transmitted to the continuous strip is varied due to frictional force increases in other drive mechanisms.

It is thus possible to make the amount of fused material and the amount of fed material equal and eliminate welding of bubble-containing material. A necessary thickness is thus obtainable, and the material that is removed by machining after the welding can be reduced. Furthermore, deviations of the distance between the outer periphery of the work and the fused end portion of the continuous strip from a reference distance can be absorbed by feeding the continuous strip with the predetermined torque noted above, and the thickness of a flange portion formed on a work, even though the outer periphery of which is not truly circular, can be automatically controlled.

In other words, a flange portion can be welded in a fixed fused state and in a fixed shape on the work, and the welding can be obtained with less material and processing,

i.e., economically, without need of sophisticated manual operation skill.

As has been described in the foregoing, according to the present invention it is the basic construction according to the present invention that, with the end face of a continuous strip held in contact with the outer periphery of the work, a front end portion of the continuous strip including the end face is heated and fused to weld the fused portion on a work, while feeding the continuous strip toward the work and moving the welding portion of the work toward the feed direction of the continuous strip.

(1) Specifically, for controlling the feeding of the continuous strip, during movement of the welding portion of the work, detecting a displacement of the continuous strip in a direction perpendicular to the feed direction of the continuous strip, and:

(i) the feed rate of the continuous strip is controlled;
(ii) the feed rate of the continuous strip and the speed of movement of the fused portion of the continuous strip are controlled; and

(iii) either the feed rate of the continuous strip or the speed of movement of the fused portion is controlled.

(2) Also, for controlling the feeding of the continuous strip, the continuous strip is fed toward the work with a predetermined torque, and the torque transmitted to the continuous strip is controlled to the predetermined torque by detecting variations of the transmitted torque.

Thus, according to the present invention, the following effects are obtainable.

Irrespective of changes in the burner heat amount or burner shape in the heating means during formation of a flange portion on a tubular portion of a tube or a vessel

from a continuous strip with the end face thereof held in contact with the outer periphery of the tubular portion, the flange portion can be formed in a fixed fused state, i.e., in a fixed shape. The flange portion can also be formed with less material or processing, i.e., economically, without need of sophisticated manual operation skill.

Since the rate of feed of the continuous strip is controlled adequately, the flange portion can be welded on the work without bubbles contained in it and also with a predetermined thickness, and it is possible to minimize the amount of material removed by machining after the welding.

The continuous strip can be lap wound by causing a plurality of rotations of the tubular portion of the work according to the invention, and it is thus possible to meet a flange portion diameter increase demand without need of replacing the continuous strip.

The fused position of the continuous strip fed toward the tubular portion is adjustable and moved according to the number of rotations of the tubular portion in this invention. Welding thus can be obtained at a most suitable fused position for lap welding of the continuous strip, and it is possible to form a satisfactory flange portion.

The continuous strip is fed with its end face held in contact with the outer periphery of the tubular portion of the work and with a predetermined torque transmitted to it, an end portion of the continuous strip including the end face is heated and fused by heating means, and the state of rotation of the tubular portion is detected by displacement detecting means, which detects a displacement of the continuous strip in a direction perpendicular to the feed direction of the continuous strip. Thus, changes in the fused state can be accurately made up for by deviation of the

fused position by the heating means, and it is possible to form a satisfactory flange portion.



Claims

1. A method of feeding a continuous strip, which permits feeding a continuous strip having a fused front end to a welding portion of a work comprising the steps of:

setting the continuous strip such that the end face thereof is in contact with the outer periphery of the work;

thermally fusing an end portion of the continuous strip including the end face and welding the fused material to the work, while feeding the continuous strip toward the work;

moving the welding portion thereof toward the feed direction of the continuous strip;

detecting a displacement of the continuous strip in a direction perpendicular to the feed direction of the continuous strip during movement of the welding portion; and

controlling the rate of feed of the continuous strip according to the detected displacement.

2. The continuous strip feeding method according to claim 1, wherein the feeding of the continuous strip is discontinued by detecting a predetermined extent of feed of the continuous strip.

3. A method of feeding a continuous strip, which permits feeding a continuous strip having a fused front end to a welding portion of a work comprising the steps of:

setting the continuous strip such that the end face thereof is in contact with the outer periphery of the work;

thermally fusing an end portion of the continuous strip including the end face and welding the fused material to the work, while feeding the continuous strip toward the work;

moving the welding portion thereof toward the feed direction of the continuous strip;

detecting a displacement of the continuous strip in a



detection perpendicular to the feed direction of the continuous strip during movement of the welding portion; and

controlling at least either the rate of feed of the continuous strip or the speed of movement of the work according to the detected displacement.

4. The continuous strip feeding method according to claim 3, wherein the feeding of the continuous strip is discontinued by detecting a predetermined extent of feed of the continuous strip or a predetermined extent of movement of the work.

5. The continuous strip feeding method according to claim 3, wherein the continuous strip is pulled back in the direction opposite to the feed direction when discontinuing the feeding of the continuous strip by detecting the predetermined extent of feed of the continuous strip or the predetermined extent of movement of the work.

6. An apparatus for feeding a continuous strip, which permits feeding a continuous strip having a fused front end to a welding portion of a work comprising:

work holding means for holding the work and movable in the direction of feed of the continuous strip;

continuous strip feeding means for feeding the continuous strip such that the end face thereof is in contact with the work;

heating means for heating and fusing a front end portion of the continuous strip including the end face;

displacement detecting means for detecting a displacement of the continuous strip in a direction perpendicular to the feed direction of the continuous strip; and

feed rate control means for controlling the rate of feed of the continuous strip;



the feed rate of the continuous strip being controllable according to the output of the displacement detecting means generated during movement of the welding portion of the work.

7. The continuous strip feeding apparatus according to claim 6, which further comprises:

calculating means for calculating the extent of feed of the continuous strip; and

discontinuous means for discontinuing the feeding operation of the continuous strip feeding means;

the feeding of the continuous strip being discontinued by obtaining an extent of feed of the continuous strip.

8. An apparatus for feeding a continuous strip, which permits feeding a continuous strip having with a fused front end to a welding portion of a work comprising:

work holding means for holding the work and movable in the direction of feed of the continuous strip;

continuous strip feeding means for feeding the continuous strip such that the end face thereof is in contact with the work;

heating means for heating and fusing a front end portion of the continuous strip including the end face;

displacement detecting means for detecting a displacement of the continuous strip in a direction perpendicular to the feed direction of the continuous strip; and

speed control means for controlling the rate of feed of the continuous strip and the speed of movement of the fusing portion of the work;

at least either the rate of feed of the continuous strip and the speed of movement of the fused portion of the work being controlled according the output of the displacement detecting means thereof generated during movement of the



welding portion of the work.

9. The continuous strip feeding apparatus according to claim 8, which further comprises:

calculating means for calculating the rate of feed of the continuous strip and the extent of movement of the fusing portion of the work; and

discontinuing means for discontinuing the feeding operation of the continuous strip feeding means;

the feeding of the continuous strip being discontinued by obtaining an extent of feed of the continuous strip or an extent of movement of the fusing portion of the work.

10. The continuous strip feeding apparatus according to claim 8, which further comprises:

pulling-back means for pulling back the continuous strip in the direction opposite to the feed direction when discontinuing the feeding operation by obtaining a predetermined extent of feed of the continuous strip or the extent of movement of the work.

11. A method for feed controlling of a continuous strip, which permits feeding a continuous strip having a fused front end to a welding portion of a work comprising the steps of:

setting the continuous strip such that the end face thereof is in contact with the outer periphery of the work; and

thermally fusing a front end portion of the continuous strip including the end face and welding the fused material to the work, while feeding the continuous strip toward the work with a predetermined torque.

12. The method for feed controlling of the continuous strip according to claim 11, wherein the torque transmitted to the continuous strip is controlled to the predetermined torque by detection variations of the transmitted torque.



13. The method for feed controlling of the continuous strip according to one of claims 11 and 12, wherein the feeding of the continuous strip is discontinued by obtaining a predetermined extent of feed of the continuous strip or a predetermined extent of movement of the work.

14. The method for feed controlling of the continuous strip according to one of claims 11 and 12, wherein the continuous strip is pulled back in the direction opposite to the feed direction when discontinuing the feeding operation by obtaining a predetermined extent of feed of the continuous strip or a predetermined extent of movement of the work.

15. An apparatus for feed controlling of a continuous strip, which permits feeding a continuous strip having a fused front end to a welding portion of a work comprising:

work holding means capable of holding the work and moving the welding portion thereof toward the feed direction of the continuous strip;

continuous strip feeding means for feeding the continuous strip such that the end face thereof is in contact with the work with a predetermined torque; and

heating means for heating and fusing a front end portion of the continuous strip including the end face.

16. The apparatus for feed controlling of the continuous strip according to claim 15, which further comprises:

torque detecting means for detecting variations of torque transmitted to the continuous strip;

clutch means for controlling the output torque from a drive source; and

clutch control means for controlling the output of the clutch means, thereby controlling the transmitted torque to the predetermined torque.

17. The apparatus for feed controlling of the continuous



strip according to one of claims 15 and 16, which further comprises:

calculating means for calculating the rate of feed of the continuous strip or the extent of movement of the fusing portion of the work; and

discontinuing means for discontinuing the feeding operation of the continuous strip feeding means;

the feeding of the continuous strip being discontinued by obtaining an extent of feed of the continuous strip or an extent of movement of the fusing portion of the work.

18. The apparatus for feed controlling of the continuous strip according to one of claims 15 and 16, which further comprises:

pulling-back means for pulling back the continuous strip in the direction opposite to the feed direction when discontinuing the feeding operation by obtaining the predetermined extent of feed of the continuous strip or the extent of movement of the work.

19. A method of manufacturing a tube or a vessel having a flange portion on the outer periphery of tubular portion comprising the steps of:

setting a continuous strip such that the end face thereof is in contact with the outer periphery of the tubular portion of the eventual tube or vessel;

heating and fusing a front end portion of the continuous strip including the end face;

rotating the tubular portion to the outer peripheral direction thereof, while feeding the continuous strip toward the tubular portion in contact therewith by applying a predetermined torque to the continuous strip;

detecting a displacement of the continuous strip in a direction perpendicular to the feed direction of the



continuous strip during rotation of the tubular portion;

and controlling the extent of rotation of the tubular portion according to the detected displacement.

20. The method of manufacturing the tube or vessel according to claim 19, wherein the feeding of the continuous strip is discontinued by obtaining a predetermined extent of feed of the continuous strip or a predetermined extent of rotation of the tubular portion of the work.

21. The method of manufacturing the tube or vessel according to claim 19, whereby the continuous strip is lap wound by causing a plurality of rotations of the tubular portion of the work.

22. The method of manufacturing the tube or vessel according to claim 21, wherein the fused position of the continuous strip fed toward the tubular portion is controlled and it is moved according to the number of rotations of the tubular portion of the work.

23. An apparatus for manufacturing a tube or a vessel having a flange portion on the outer periphery of tubular portion, comprising:

work mounting/moving means for holding the tube or vessel (i.e., work) and capable of causing rotation of the work toward the outer periphery thereof;

continuous strip feeding means for feeding a continuous strip with the end face thereof in contact with the outer periphery of a tubular portion of the work by providing a predetermined torque to the continuous strip;

heating means for heating and fusing a front end portion of the continuous strip including the end face;

displacement detecting means for detecting a displacement of the continuous strip in a direction perpendicular to the feed direction of the continuous strip;



and

rotational speed control means for controlling the rotational speed of the work mounting/moving means;

the rotational speed of the work mounting/moving means being controlled according to the output of the displacement detecting means generated during rotation of the tubular portion of the work.

24. The apparatus for manufacturing the tube or vessel according to claim 23, which further comprises:

calculating means for calculating the extent of feed of the continuous strip or the extent of rotation of the tubular portion of the work; and

discontinuing means for discontinuing the feeding operation of the continuous strip feeding means;

the feeding of the continuous strip being discontinued by obtaining the extent of feed of the continuous strip or the extent of rotation of the tubular portion of the work.

25. The apparatus for manufacturing the tube or vessel according to claim 24, which further comprises:

heating means capable of adjusting the fusion position of a heated object.