

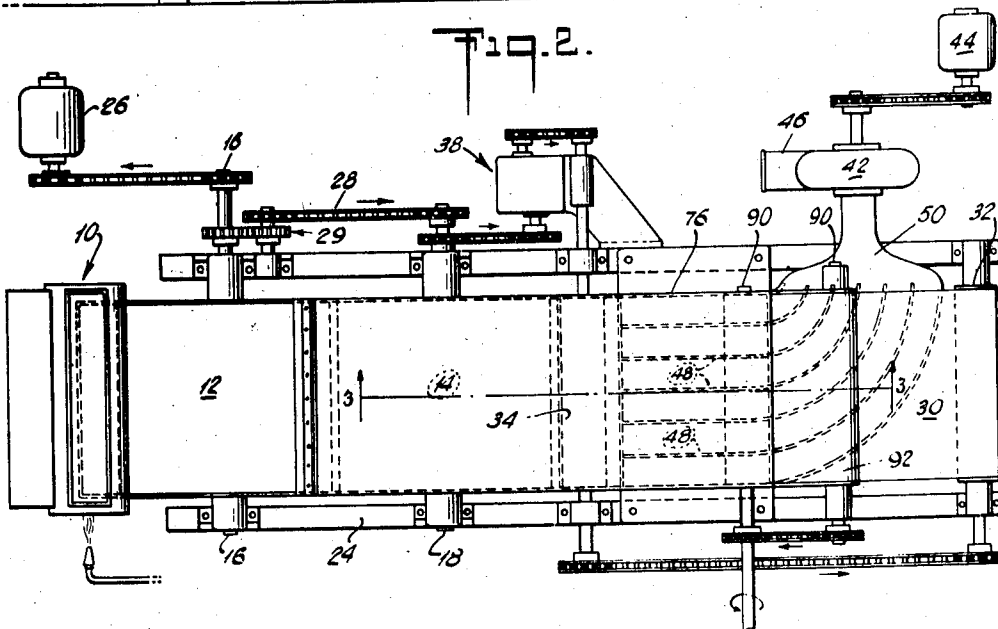
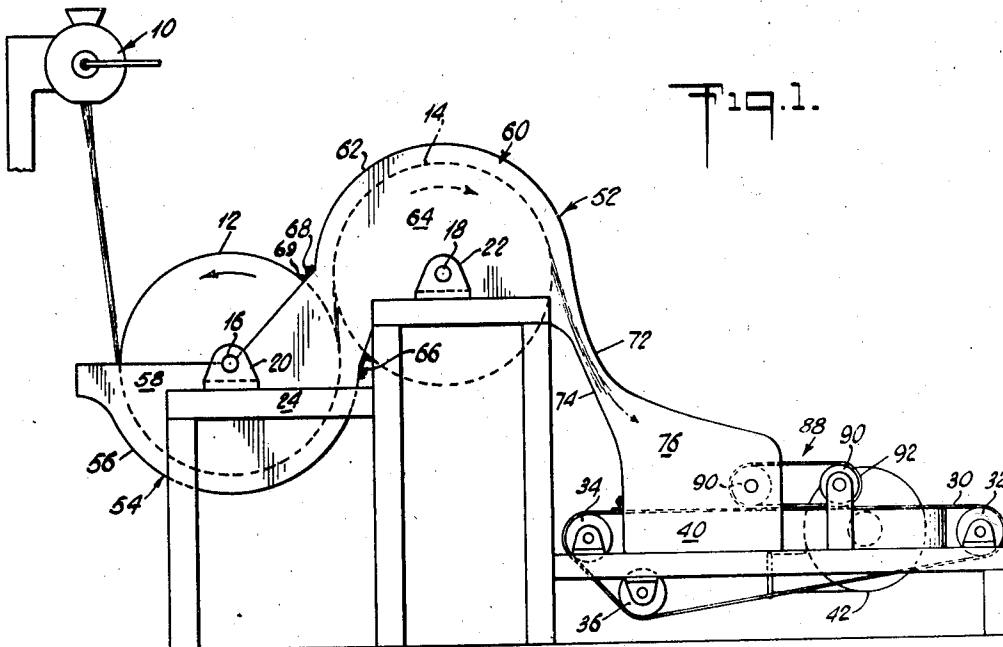
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P. MODIGLIANI ET AL
METHOD OF MAT FORMATION

2,460,899

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2 Sheets-Sheet 1



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2 Sheets-Sheet 2

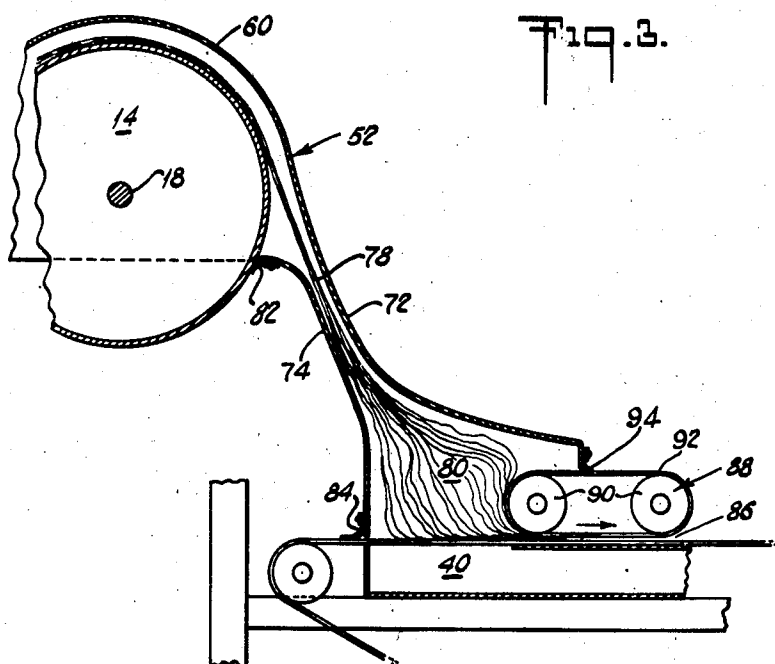
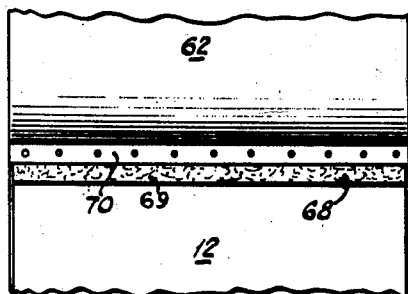


Fig. 4.



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METHOD OF MAT FORMATION

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The instant invention relates to the production of filaments, fibers and the like, and in its more specific phase, relates to the production of such filaments and their collection in the form of a mat or felt.

The invention is particularly concerned with the production of filaments of glass and like raw materials, and has for its principal object the provision of an improved method and apparatus for drawing and accumulating continuous or substantially continuous glass or similar filaments.

Another object of the invention is the provision of an improved apparatus and method for forming a mat of glass or like fibers. As distinguished from known practices involving, for example, the felting of relatively short fibers, or the formation of multi-layered mats in which the filaments of the layers are reoriented after their collection to lie in criss-cross relationship, the invention provides a mat of relatively uniform, open structure with substantially continuous filaments extending in generally parallel directions but in tangled or felted relationship. A further object of the invention is the provision of a method and apparatus which may be employed to form very thin but uniform mats of the type referred to.

A further object of the invention is the provision of an apparatus including a drawing drum or drums against which the filaments are led from the body of filament forming material, such as molten glass, and means for holding the filaments in frictional contact with the drums, whereby the filaments are continuously drawn out by said drums, said means additionally serving to convey the filaments to a collecting member and to lay them thereon in relatively felted or tangled relationship.

A still further object of the invention in a preferred embodiment thereof is the provision of an apparatus as described above, including one or more, preferably two, drawing drums or rotors, a filament collecting conveyor adjacent the forward rotor, means to set up a flow of air, and a housing or shield requiring said flow of air to move in the direction of travel of said filaments to create a tension thereon to maintain frictional contact between the continuously drawn filaments and the drums; and to carry the filaments to and deposit the same on the conveyor.

Our invention will be more fully understood and further objects and advantages thereof will become apparent when reference is made to the more detailed description of a preferred embodiment thereof which is to follow and to the accompanying drawings in which:

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Fig. 1 is a diagrammatic, side elevational view of an apparatus in accordance with the invention;

Fig. 2 is a diagrammatic, top plan view of the apparatus of Fig. 1 with the drive omitted for clearness of illustration;

Fig. 3 is an enlarged sectional view taken on the line 3-3 of Fig. 2; and

Fig. 4 is an enlarged detail view of a portion of the apparatus shown on Figs. 1 and 2.

Referring now to the drawings, the apparatus includes a glass melting furnace 10 of any suitable type as, for example, a conventional gas fired furnace. Furnace 10 has an orifice plate provided with a plurality of small orifices or openings arranged preferably in a plurality of rows. The glass exudes through the orifices in the form of fine streams which are drawn out into filaments by the drawing means to be described. Where a relatively wide mat of fibers is to be formed, say one of several feet in width, as is preferred, a single elongated gas furnace may be employed, or several furnaces may be used to produce the multiplicity of filaments required, the furnaces being positioned to distribute the filaments substantially uniformly over the selected area of the drawing means. It will be understood, in this connection, that the particular type of melting furnace employed, or other means provided for supplying the plurality of fine streams of glass or other viscous material, forms no part of the instant invention and may take many different forms.

In accordance with the preferred embodiment of the invention and for carrying out the method thereof, the means for drawing the filaments from the several orifices comprises a pair of rotors or drums 12 and 14 mounted for rotation at relatively high peripheral velocities on parallel shafts 16 and 18, supported as, for example, on bearings 20 and 22 carried by frame 24. The rotors may be driven as by a motor 26 (see Fig. 2) having a driving belt connection with shaft 16. Shafts 16 and 18 are operatively connected for rotation of the rotors or drums 12 and 14 in the directions indicated by the arrows at substantially equal peripheral velocities by a sprocket chain or the like 28 and gearing 29.

The rotors or drums are suitably of relatively large size having diameters, say of 3 to 5 feet, to provide a substantial area of contact with filaments to be drawn and to enable the rotors to be driven at peripheral velocities of the order of 5,000 to 9,000 feet per minute without excessive R. P. M. The drums may be of the same or dif-

ferent diameters as desired, but in any event are rotated to have substantially equal peripheral velocities, as previously pointed out.

A conveyor 30 made of wire mesh screen or other foraminous material is located forwardly of drum 14 and preferably substantially below it, as illustrated. The conveyor is carried, as by rolls 32, 34 and 36, having shafts mounted, in suitable bearings supported from the frame. One or more of the rolls, for example roll 34, may be driven from any suitable source of power, as indicated diagrammatically at 38. A variable drive is preferably employed to permit adjustments to be made in the speed of the travel of the conveyor relatively to the peripheral velocities of the drums or rotors. Conveyor 30 is of a width substantially equal to the lengths of the drums.

Located below the upper reach of conveyor 30 is a suction box 40 connected into the air intake side of a suction fan or the like 42, which may be driven from an available source of power such as motor 44. The suction box has an open mouth adjacent the conveyor extending substantially across the conveyor. The exhaust side 46 of the fan may lead to the atmosphere. The suction box is constructed to provide a substantially uniform flow of air through the conveyor over the area of its open mouth. Any desired or conventional air distributing arrangement may be employed for this purpose but, for purposes of example, the box may be divided, as shown, into a plurality of compartments by walls 48, each compartment being connected through a separate channel or conduit with a manifold 50 in communication with the intake side of the fan.

A housing or shield, indicated generally at 52, is employed to confine the airstream set up by suction box 40 to a definite path. As shown particularly in Fig. 1, housing 52 includes a rear section 54 having a wall 56 substantially concentric with and spaced a relatively short distance, say 1 to 3 inches, from rotor or drum 12, and side plates 58 extending closely adjacent to and suitably sealed against the ends of the drum. Section 60 of the housing is similar and includes wall 62, concentric with drum or rotor 14 and spaced a similar distance therefrom, and side plates 64, preferably formed as a continuation of side plates 58 and lying closely adjacent to or sealed against the ends of the drum to prevent substantial leakage of air therebetween. At the points where walls 56 and 62 intersect drums 14 and 12 respectively, resilient wipers 66 and 68 are provided. These wipers may be of any suitable construction, but at least wiper 68 is preferably formed of a relatively stiff blade 69, which may be made of friction material or the like, with its outer edge bearing against and wiping the surface of drum 12. The blade may be supported from the housing by a keeper plate 70 or the like secured to the housing by bolts or rivets (see Fig. 4).

Housing 52 extends from rotor 14 to the conveyor 30 to define a restricted passageway leading substantially tangentially from the rotor. This section of the housing includes an outer wall 72, inner wall 74 and side walls 76. Outer and inner walls 72 and 74 define a restricted passageway or throat 78 opening into an expanded felting chamber 80. Inner wall 74 is sealed against drum 14 by wiper 82, preferably of similar construction to wiper 68. Wall 74 is also sealed against conveyor 30 as by flexible wiper 84. The outer wall 72 is spaced a substantial distance above the conveyor and this

space is closed, with the exception of an exit port 86, by rotary seal 88. As shown, the seal suitably comprises a pair of rollers 90 supporting a substantially air-impervious apron 92. The rollers may be driven from any suitable source of power, preferably from the same source as conveyor 30, with the apron traveling at the same speed as the conveyor. The lower edge of wall 72 is sealed against the apron by a wiper 94. In lieu of the apron a single roll or other means may be employed. The sealing means is suitably made vertically adjustable by conventional means (not shown) to widen or narrow port 86 to accommodate mats of various thicknesses.

In the operation of the apparatus described above, and in carrying out the method of the instant invention, a plurality of glass streams issuing from the orifices of furnace 10 are drawn out into filamentary form and carried in substantially parallel, evenly spaced relationship around the lower peripheral surface of drum 12, and from thence around the upper peripheral surface of drum 14 and then tangentially therefrom to felting chamber 80. The rotors are rotated at relatively high speed, say to have peripheral velocities of the order of 5,000 to 9,000 feet per minute, and blower 42 is operated to set up a flow of air in the passageway defined by housing 52 and through the upper reach of the foraminous conveyor at the open mouth of suction box 40. Blower 42 is of such capacity and is driven at such speed as to provide an airstream flowing through the restricted passages adjacent the peripheries of drums 12 and 14, and through throat 78, at a substantially greater velocity than the peripheral speeds of the drums, say at one and a half times their peripheral speeds. Inasmuch as the narrowest part of the passageway is at throat 78 the airstream will have its highest velocity at this point and thus will exert its greatest pull on the filaments. As will be appreciated, due to the much greater area of felting chamber 80, the velocity of air movement in the chamber will be substantially lower than in any part of the passageway.

The fibers are drawn continuously from the orifices of the furnace by the rotation of rotors 14 and 16, the fibers being held in frictional contact with the rotors due to the tension exerted on them by the high velocity airstream in the restricted passageways, and particularly in throat 78. As the continuous filaments enter felting chamber 80 through throat 78, they are carried toward the open mouth of suction box 40. Due to the reduced velocity of the airstream in the felting chamber, the filaments tend to whip around and become entangled on the upper reach of the conveyor to form a felted mat of interlaced, continuous or substantially continuous filaments. The conveyor is driven forwardly at a predetermined rate whereby the filaments extend generally longitudinally of the conveyor although in the entangled relationship referred to. The mat thus formed may be carried by conveyor 30 to any suitable location where it may be subjected to further operations.

The thickness of the mat may be varied as desired by proper control of the speed of conveyor 30 relative to the peripheral speeds of the drums or rotors.

The instant invention may be employed for the production of mats or felts of any desired thickness including very thin mats, say of 2 mils thickness, and still obtain substantial uniformity of structure. This result is due to the

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manner in which the filaments are carried in spaced relationship and as continuous filaments to the felting zone where they are laid in interlaced relationship directly on the conveyor. As distinguished from prior practice, the method and apparatus produces mats or felts of uniform, open characteristics in a continuous, substantially automatic operation, requiring no re-orientation of the fibers.

Having thus described our invention in rather full detail, it will be understood that these details need not be strictly adhered to and that various changes and modifications may suggest themselves to one skilled in the art, all falling within the scope of the invention as defined by the subjoined claims.

What we claim is:

1. In the method of forming a filamentary mat, the steps comprising leading a plurality of filaments integrally connected with a supply body of molten glass or the like into frictional contact with a cylindrical surface, carrying said filaments on said surface through an arcuate path and leading said filaments from said surface to a second surface, carrying said filaments on the second surface through an arcuate path of reverse contour with respect to said first path and creating a flow of air moving at a speed greater than that of the filaments, said flow of air passing along said surfaces and then substantially tangentially therefrom in the direction of travel of said filaments to longitudinally tension said filaments and thereby maintain said frictional contact between said filaments and said surfaces and to carry said filaments to a collecting zone.

2. In an apparatus for forming fibrous materials including means for supplying streams of molten glass to be drawn out into filaments, the improvement comprising a drum adapted to be rotated at a relatively high velocity, and having a continuous surface to be contacted by the filaments drawn from the glass streams, means for rotating the drum, means to set up a flow of air, means for receiving said filaments from said drum, and means directing said flow of air along said surface of said drum for a substantial distance and in an arcuate path through a portion of the travel thereof and then substantially tangentially therefrom to longitudinally tension said filaments and thereby hold them in frictional contact with said drum during their travel thereon and to carry them to said receiving means.

3. In an apparatus for forming fibrous materials including means for supplying streams of molten glass to be drawn out into filaments, the improvement comprising a drum adapted to be rotated at relatively high velocity and having a continuous surface to be contacted by the filaments drawn from the glass streams, means for rotating the drum, suction means to set up a flow of air, means for receiving said filaments, and means directing said flow of air along said surface of said drum through a portion of the travel thereof and then substantially tangentially therefrom to said receiving means to longitudinally tension said filaments and thereby hold them in frictional contact with said surface during their travel thereon and to carry them to said receiving means.

4. In an apparatus for forming fibrous materials including means for supplying streams of molten glass to be drawn out into filaments, the improvement comprising a drum having a continuous surface positioned to receive the fila-

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ments drawn from said streams, means for rotating the drum, means for receiving said filaments from said drum comprising a foraminous conveyor adjacent said drum, suction means acting through said foraminous conveyor for creating an airstream, and means for directing said airstream along the surface of said drum and then substantially tangentially therefrom to said conveyor to hold said filaments in frictional contact with said drum during their travel thereon and to carry them to said conveyor.

5. In an apparatus for forming fibrous mats or the like including means for supplying a plurality of streams of molten glass to be drawn out into filaments, the improvement comprising a drum positioned to receive said filaments on its peripheral surface, means to rotate said drum, a foraminous conveyor adjacent said drum, a housing enclosing a portion of said drum surface contacted by said filaments and a filament receiving area of said conveyor, and suction means acting through said foraminous conveyor to set up a flow of air along said portion of said drum and to said receiving area.

6. In an apparatus for forming fibrous materials including means for supplying a plurality of streams of molten glass to be drawn out into filaments, the improvement comprising a rotor positioned to receive said filaments and carry them in an arcuate path, a second rotor adjacent said first rotor and positioned to receive the filaments from said first rotor and carry them in an arcuate path reversed with respect to said first mentioned path, means for receiving the filaments from said second rotor, and means for creating a flow of air acting on said filaments to maintain them in frictional contact with said rotors and to carry them from said second rotor to said receiving means.

7. In an apparatus for forming fibrous materials including means for supplying a plurality of streams of molten glass, the improvement comprising a rotor positioned to receive said filaments and carry them in an arcuate path, a second rotor adjacent said first rotor and positioned to receive the filaments from said first rotor and carry them in an arcuate path reversed with respect to said first mentioned path, means for receiving the filaments from said second rotor, means for creating a flow of air acting on said filaments to maintain them in frictional contact with said rotors and to carry them from said second rotor to said receiving means, and a housing defining the path of said travel of said airstream.

8. In a method of forming a filamentary mat, the steps comprising leading a plurality of filaments integrally connected with a supply body of a molten material against a cylindrical surface to have an extended arc of contact therewith, rotating said surface at high speed, maintaining a flow of a fluid medium in the direction of movement of and in contact with said filaments through said arc of contact to tension said filaments and maintain their contact with said surface, and collecting said filaments in matted relationship.

9. In a method of forming a filamentary mat, the steps comprising leading a plurality of filaments integrally connected with a supply body of a molten material against a cylindrical surface to have an extended arc of contact therewith, rotating said surface at high speed, maintaining a flow of a fluid medium moving at a velocity greater than the rate of movement of

said filaments and in the direction of movement of and in contact with said filaments through said arc of contact and then tangentially from said surface to tension said filaments and maintain their contact with said surface, and collecting said filaments in matted relationship.

10. In a method of forming a filamentary mat, the steps comprising leading a plurality of filaments integrally connected with a supply body of a molten material against a cylindrical surface to have an extended arc of contact therewith, rotating said surface at high speed, maintaining a flow of a fluid medium moving at a velocity greater than the rate of movement of said filaments and in the direction of movement of and in contact with said filaments through said arc of contact and then tangentially from said surface, increasing the velocity of said fluid medium after it leaves said surface, and collecting said filaments in matted relationship.

11. In a method of forming a filamentary mat, the steps comprising leading a plurality of filaments integrally connected with a supply body of molten glass or the like into frictional contact with a cylindrical surface, carrying said filaments on said surface through an arcuate path and leading said filaments from said surface to a second cylindrical surface, carrying said filaments on said second surface through an arcuate path of reverse contour with respect to said first surface and creating a flow of air moving at a speed greater than that of the filaments, said flow of air passing along said surfaces and then substantially tangentially from said second surface in the direction of travel of said filaments, increasing the velocity of said airflow after it leaves said second surface, and collecting said filaments.

12. In an apparatus for forming fibrous mats or the like including means for supplying a plurality of streams of molten glass to be drawn out into filaments, the improvement comprising a drum positioned to receive said filaments on its peripheral surface, means to rotate said drum, receiving means adjacent said drum, a housing enclosing an area of said drum surface contacted by said filaments and a fiber receiving area of said receiving means, said housing defining a restricted passageway along said drum surface, and means for setting up a flow of air within said passageway directed to said receiving means to tension said filaments and maintain them in contact with said surface and to cause deposit of the same on said receiving means.

13. In an apparatus for forming a fibrous material including means for supplying glass streams to be drawn out into filaments, the improvement comprising a surface adapted to be moved at a relatively high velocity and to be contacted by the filaments drawn from the glass stream, means for moving said surface, means for setting up a flow of air traveling along said surface for a substantial distance and when tangentially there-

from, and means for increasing the velocity of said airflow during the tangential travel thereof.

14. In an apparatus for forming fibrous mats or the like including means for supplying a plurality of streams of molten glass to be drawn out into filaments, the improvement comprising a drum positioned to receive said filaments on its peripheral surface, means to rotate said drum, a housing enclosing a portion of said drum surface contacted by said filaments, said housing defining a passageway extending along said surface and then substantially tangentially therefrom, a restricted neck portion in said passageway, means for receiving the filaments and means for setting up a flow of air within said passageway and in the direction of movement of said filaments.

15. In the method of forming a filamentary mat, the steps comprising leading a plurality of filaments integrally connected with a supply body of molten glass or the like into contact with a cylindrical surface, carrying said filaments on said surface through an arcuate path, leading said filaments from said surface to a second surface, carrying said filaments on the second surface through an arcuate path of reverse contour with respect to said first surface, and exerting tension on said filaments to hold them in said frictional contact against said surfaces by creating a flow of air moving along said surfaces in said arcuate paths and in the direction of travel of said filaments.

16. In an apparatus for forming a fibrous material including means for supplying glass streams to be drawn out into filaments, the improvement comprising a surface adapted to be moved at a relatively high velocity and to be contacted by the filaments drawn from the glass streams, means for moving said surface, means for setting up a flow of air, means for directing said flow of air for a substantial distance along said surface and in contact with said filaments for said distance to longitudinally tension said filaments and thereby hold them in frictional contact with said surface during a substantial portion of travel thereof, and means for receiving said filaments from said surface.

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Certificate of Correction

February 8, 1949.

Patent No. 2,460,899.

PIERO MODIGLIANI ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 7, line 62, claim 13, for the word "when" read *then*;
and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 6th day of September, A. D. 1949.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.