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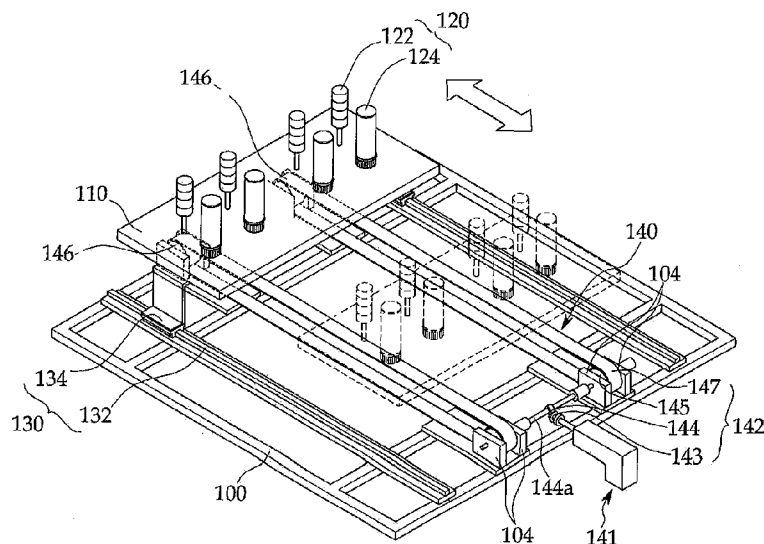
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(54) Title: EVAPORATION APPARATUS

FIG. 1



(57) Abstract: Disclosed is an evaporation apparatus, which includes a moving plate disposed on the frame to be reciprocated, a plurality of evaporation sources for evaporating an evaporation material onto a substrate so as to deposit the evaporation material on the substrate in which the plurality of evaporation sources is arranged in a direction intersecting a movement direction of the moving plate on the moving plate, and a driving unit for reciprocating the moving plate. The evaporation apparatus can be simplified in structure, and can deposit the evaporation material with a uniform thickness on the substrate in a short time.



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EVAPORATION APPARATUS

BACKGROUND OF THE INVENTION

5 1. Field of the invention

The present invention relates to an evaporation apparatus, and more particularly to an evaporation apparatus which can deposit evaporation materials on large-size substrates in uniform thickness while having a simplified structure.

10

2. Description of the Prior Art

Evaporation apparatus are generally used for depositing materials on substrates by heating and evaporating the materials filled into an evaporation source in a vacuum chamber exhausted and decompressed by a vacuum pump.

15

Recently, the need for an evaporation apparatus capable of depositing evaporation materials on a substrate in a short time has been rising. As an example of it, an evaporation apparatus which is provided with a large-size evaporation source having an elongated opening with a width equal to the width of a substrate and performs evaporation process while moving the substrate has been developed. In the case of this apparatus, scaling-up is inevitable due to a space required for the movement of the substrate, and the uniformity of a deposited film is low since the temperature control of the large-size source is difficult.

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For this reasons, an evaporation apparatus which is provided with one evaporation source capable of moving while evaporating a material onto a suspended substrate has been developed. However, this evaporation apparatus requires a long process time and uses a moving part including a ball screw which generates many particles.

30

Research is also ongoing to develop an evaporation apparatus which is provided with a plurality of evaporation units each including one source and one moving part to evaporate a material

onto a large-size substrate in a short time. This apparatus, however, becomes complex and expensive since it needs a plurality of moving parts to move a plurality of evaporation sources.

5

SUMMARY OF THE INVENTION

Accordingly, the present invention has been made to solve the above-mentioned problems occurring in the prior art, and it is an object of the present invention to provide an evaporation
10 apparatus which can shorten the process time of evaporation and improve the thickness uniformity of an evaporation material deposited on a substrate.

Another object of the present invention is to provide an evaporation apparatus which can be simplified in structure and can
15 minimize the generation of particles.

The objects of the present invention is accomplished by an evaporation apparatus which includes a moving plate disposed on a frame to be reciprocated; a plurality of evaporation sources for evaporating an evaporation material onto a substrate so as to
20 deposit the evaporation material on the substrate, the plurality of evaporation sources being arranged in a direction intersecting a movement direction of the moving plate on the moving plate; and a driving unit for reciprocating the moving plate.

In accordance with an embodiment of the present invention,
25 the evaporation apparatus includes a guide unit for guiding the reciprocating movement of the moving plate which includes a guide rail disposed in the frame; and a guide member secured to the moving plate and having a guide groove into which the guide rail is inserted.

30 The driving unit includes a driving motor; and a power transmission unit for transmitting a driving force of the driving motor to the moving plate so that the moving plate is moved. The power transmission unit includes a drive pulley rotatably disposed

in the frame and driven by the driving motor; an idler pulley rotatably disposed in the frame, the idler pulley being spaced apart from the drive pulley in the movement direction of the moving plate; a steel belt drivingly connecting the drive pulley and the idler pulley wherein the moving plate is secured to the steel belt; and a pair of bevel gears transmitting the driving force to the drive pulley, wherein the drive pulley, the idler pulley, and the steel belt are each plural in number being spaced apart from one another in the direction intersecting the movement direction of the moving plate.

In addition, the evaporation sources include a plurality of host evaporation sources arranged to be spaced apart from one another in the direction intersecting the movement direction of the moving plate, and guest evaporation sources having a number corresponding to the number of the host evaporation sources and each disposed to be apart in the movement direction of the moving plate from the corresponding the host evaporation source.

In accordance with another embodiment of the present invention, the drive pulley is coupled to the driving shaft of the driving motor so that the pair of bevel gears can be omitted.

Meanwhile, the objects of the present invention can also be accomplished by an evaporation apparatus which includes a driving motor; a moving plate disposed on the frame to be reciprocated; at least one evaporation source disposed on the moving plate, the at least one evaporation source evaporating an evaporation material onto a substrate so as to deposit the evaporation material on the substrate; and a steel belt connected to the moving plate secured thereto, the steel belt reciprocating the moving plate when being driven by the driving motor.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the

present invention will be more apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a schematic perspective view of an evaporation
5 apparatus according to an embodiment of the present invention;

FIG. 2 is a side view of the evaporation apparatus shown in FIG. 1;

FIG. 3 is a sectional view of the evaporation apparatus shown in FIG. 1; and

10 FIG. 4 is a perspective view of an evaporation apparatus according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

15 Hereinafter, an exemplary embodiment of the present invention will be described with reference to the accompanying drawings.

Referring to FIGS. 1 to 3, an evaporation apparatus according to an embodiment of the present invention includes a
20 frame 100, a moving plate 110 which is mounted to the frame 100 in such a manner that it is linearly reciprocable on the frame 100, a plurality of evaporation sources 120 disposed on the moving plate 110, guide units 130 for guiding the linear movement of the moving plate 110, and a driving unit 140 for linearly
25 reciprocating the moving plate 110.

The moving plate 110 is used for supporting and moving the plurality of evaporation sources 120 all together, and has a top surface on which the plurality of evaporation sources 120 are disposed and a bottom surface on which a pair of connecting
30 members 112 for connecting the moving plate 110 to the driving unit 140 is disposed. In addition, a pair of supporting members 114 is disposed on the bottom surface of the moving plate 110 for supporting the moving plate 110 on the guide units 130. While in

this embodiment the moving plate 110 is illustrated to be of a rectangle plate, it can have various modified shapes and be formed of various materials as long as it can support the plurality of evaporation sources 120 and move with them.

5 The plurality of evaporation sources 120 are arranged on the top surface of the moving plate 110 in a direction perpendicular to a movement direction of the moving plate 110. It is preferred that the plurality of evaporation sources 120 are spaced at the same intervals so that the evaporation material can be deposited
10 with a uniform thickness according to the position of the substrate. Meanwhile, in the case of evaporating organic EL materials, each of the plurality of evaporation sources 120 may include a host evaporation source 124 and a guest evaporation source 122 which are spaced apart from each other in the movement
15 direction of the moving plate 110. The host evaporation sources 124 are filled with a host material, and the guest evaporation sources 122 are filled with a guest material as a dopant, so that the host and guest materials can be deposited on a substrate at the same time.

20 These evaporation sources 120 may each have a known construction that is provided with a crucible filled with an evaporation material and an electrothermal wire disposed around the crucible to heat and evaporate the evaporation material. The detailed descriptions of the evaporation principle and
25 construction of the evaporation source 120 will be omitted since the configuration of the evaporation source 120 is already well-known.

 In addition, sensors (not shown) including quartz vibrators may be disposed near the respective evaporation sources 120 for
30 measuring evaporation of the evaporation sources 120. A controller is operable to control evaporation rates of the respective evaporation sources 120 by adjusting the respective temperature thereof based on the measured evaporation of the

respective evaporation sources 120.

The guide units 130 are used for guiding the linear reciprocating movement of the moving plate 110, and each includes a guide member 134 provided to each of the supporting members 114
5 and a guide rail 132 provided to the frame 100. The guide member 134 has a guide groove 135 into which the guide rail 132 is inserted. With the above structure, the moving plate 110 linearly reciprocates along the guide rails 132.

While, in this embodiment, the guide rails 132 are fixed to
10 the frame 100 and the guide members 134 with the respective guide grooves 135 are fixed the moving plate 110, it is also possible, contrary to this embodiment, that the guide rails 132 are fixed to the moving plate 110 and the guide grooves are formed in the frame 100.

15 The driving unit 140 is used for moving the moving plate 110, and includes a driving motor 141 and a power transmission unit 142 for transmitting driving force of the driving motor 141 to moving plate 110.

The driving motor 141 is secured to the frame 100 and is
20 rotatable forward and backward in response to supplied electric current directions, thereby allowing the moving plate 110 to be reciprocated.

The power transmission unit 142 includes a pair of bevel gears 143 and 144 connected to a drive shaft 141a of the driving
25 motor 141 and having shafts crossing each other, drive pulleys 145 connected to the bevel gears 143 and 144, idler pulleys 146 drivingly connected to the respective drive pulleys 145 by steel belts 147, and the steel belts 147 transmitting driving force of the drive pulleys 145 to the idler pulleys 146.

30 The bevel gears 143 and 144 include the first bevel gear 143 connected to the drive shaft 141a of the driving motor 141 and the second bevel gear 144 having a shaft perpendicular to a shaft of first bevel gear 143. The first bevel gear 143 and second bevel

gear 144 are used to convert a rotation direction of the driving force since the drive shaft 141a of the driving motor 141 is perpendicular to a shaft of the drive pulleys 145. Thus, the first bevel gear 143 and second bevel gear 144 can be omitted
5 according to the location and position of the driving motor 141.

The drive pulleys 145 include a pair of pulleys disposed at the opposite sides with respect to the driving motor 141. More specifically, the pair of drive pulleys 145 is rotatably mounted to supporting ribs 104 of the frame 100, respectively, and the
10 drive pulleys 145 share a shaft 144a with the second bevel gear 144. Thus, the rotatory power of the second bevel gear 144 is transferred through the shaft 144a to the drive pulleys 145.

The idler pulleys 146 are driven by the drive pulleys 145 and disposed a distance apart from the drive pulleys 145 in the
15 movement direction of the moving plate 110. The idler pulleys 146 are a pair of pulleys corresponding to the pair of drive pulleys 145 and rotatably mounted to supporting ribs of the frame 100.

The steel belts 147 are a pair of steel belts, each of which is connected with the corresponding drive pulley 145 and idler pulley 146 so as to rotate. Thus, the moving plate 110 is secured
20 at a point of each of the steel belts 147. More specifically, the connecting members 112 attached to the moving plate 110 are fixed to the respective steel belts 147. With this structure, the moving plate 110 is linearly moved along the guide rails 132 when
25 the steel belts 147 rotate. Since the steel belts 147 are employed as the power transmission members for moving the moving plate 110 as mentioned above, particles, which would be generated at a much higher rate in other power transmission members with greater friction, such as ball screws, can be minimized. The
30 minimized particles allow the reduced fraction defective of the substrates deposited with evaporation materials. Meanwhile, a housing may be disposed to cover the steel belts 147, the drive pulleys 145, and the idler pulleys 146. In this case, the

fraction defective of the substrates generated by the particles can be more reduced since the power transmission unit 142 is sealed with respect to the substrates.

Hereinafter, the operation of the evaporation apparatus with
5 the configuration above will be described.

First, a substrate is mounted to face the evaporation sources 120, and electric power is applied to the evaporation sources 120 to evaporate the evaporation material. At this time, the driving motor 141 is actuated to move the moving plate 110
10 along the guide rails 132. More specifically, when the driving motor 141 is actuated, the pair of drive pulleys 145 is rotated through the first bevel gear 143 and second bevel gear 144 and the steel belts 147, which are coupled to the respective drive pulleys 145 by a frictional force, rotate. The moving plate 110 fixed at
15 a point of the respective steel belts 147 is then moved. At this time, the plurality of evaporation sources 120 mounted to the moving plate 110 evaporate the evaporation material onto the whole substrate while moving in the longitudinal direction of the substrate.

FIG. 4 is a schematic perspective view of an evaporation
20 apparatus according to another embodiment of the present invention. Referring to FIG. 4, omitted in this embodiment of the present invention is the first bevel gear 143 and second bevel gear 144 used in the above embodiment by changing the position of
25 a driving motor 241. Namely, a power transmission unit 242 according to another embodiment of the present invention includes a driving motor 241, of which a drive shaft 241a is directly connected with a drive pulley 245. The drive pulley 245 is then connected with an idler pulleys 246 by a steel belt 247. Here, it
30 is preferred that the steel belt 247, the drive pulley 245, and the idler pulleys 246 are positioned in the middle of the width of a moving plate 210. This is to more effectively transmit the driving force in a movement direction of the moving plate 210.

Except this, a structure for connecting the moving plate 210 with the steel belt 247 and a structure for guiding the movement of the moving plate 210 are the same as those of the above embodiment.

In this way, the structure of the evaporation apparatus can
5 be more simplified by directly connecting the drive pulley 245 to the drive shaft 241a of the driving motor 241.

In accordance with the present invention described above, since the evaporation material is deposited onto the suspended substrate by evaporating the evaporation material from the
10 plurality of evaporation sources supported on the one moving plate reciprocating, the structure of the evaporation apparatus can be simplified, the deposition time can be reduced, and the temperature control of each of the evaporation sources can be easily performed and thus the uniform thickness of the deposited
15 films can be obtained.

Particularly, by using the driving motor and the steel belt to reciprocate the moving plate supporting the plurality of evaporation sources, the structures of the moving parts of the evaporation apparatus can be more simplified, and the particles
20 from the moving parts can be minimized.

In addition, the driving shaft of the driving motor is directly connected with the drive pulley, thereby allowing the structure of the driving unit to be more simplified.

Although an exemplary embodiment of the present invention
25 has been described for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

WHAT IS CLAIMED IS:

1. An evaporation apparatus comprising:
a moving plate disposed on a frame to be reciprocated;
5 a plurality of evaporation sources for evaporating an evaporation material onto a substrate so as to deposit the evaporation material on the substrate, the plurality of evaporation sources being arranged on the moving plate in a direction intersecting a movement direction of the moving plate;
10 and
a driving unit for reciprocating the moving plate.
2. The evaporation apparatus as claimed in claim 1, comprising a guide unit for guiding the reciprocating movement of
15 the moving plate.
3. The evaporation apparatus as claimed in claim 2, wherein the guide unit comprises:
a guide rail disposed in the frame; and
20 a guide member secured to the moving plate and having a guide groove into which the guide rail is inserted.
4. The evaporation apparatus as claimed in claim 1 or 3, wherein the driving unit comprises:
25 a driving motor; and
a power transmission unit for transmitting a driving force of the driving motor to the moving plate so that the moving plate is moved.
- 30 5. The evaporation apparatus as claimed in claim 4, wherein the power transmission unit comprises:
a drive pulley rotatably disposed in the frame and driven by the driving motor;

an idler pulley rotatably disposed in the frame, the idler pulley being spaced apart from the drive pulley in the movement direction of the moving plate; and

a steel belt drivingly connecting the drive pulley and the
5 idler pulley wherein the moving plate is secured to the steel belt at a point,

wherein the steel belt is rotated to reciprocate the moving plate when the drive pulley and the idler pulley rotate.

10 6. The evaporation apparatus as claimed in claim 5, wherein the power transmission unit comprises a pair of bevel gears transmitting the driving force to the drive pulley.

7. The evaporation apparatus as claimed in claim 6,
15 wherein the drive pulley is coupled to the driving shaft of the driving motor.

8. The evaporation apparatus as claimed in claim 5, wherein the drive pulley, the idler pulley, and the steel belt are
20 each plural in number which are spaced apart from one another in the direction intersecting the movement direction of the moving plate.

9. The evaporation apparatus as claimed in claim 1,
25 wherein the evaporation sources comprise:

a plurality of host evaporation sources arranged to be spaced apart from one another in the direction intersecting the movement direction of the moving plate; and

30 guest evaporation sources having a number corresponding to the number of the host evaporation sources and each disposed to be apart in the movement direction of the moving plate from the corresponding the host evaporation source.

10. An evaporation apparatus comprising:
- a driving motor;
 - a moving plate disposed on the frame to be reciprocated;
 - at least one evaporation source disposed on the moving
 - 5 plate, the at least one evaporation source evaporating an
 - evaporation material onto a substrate so as to deposit the
 - evaporation material on the substrate; and
 - a steel belt connected to the moving plate secured thereto,
 - the steel belt reciprocating the moving plate when being driven by
 - 10 the driving motor.

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FIG. 1

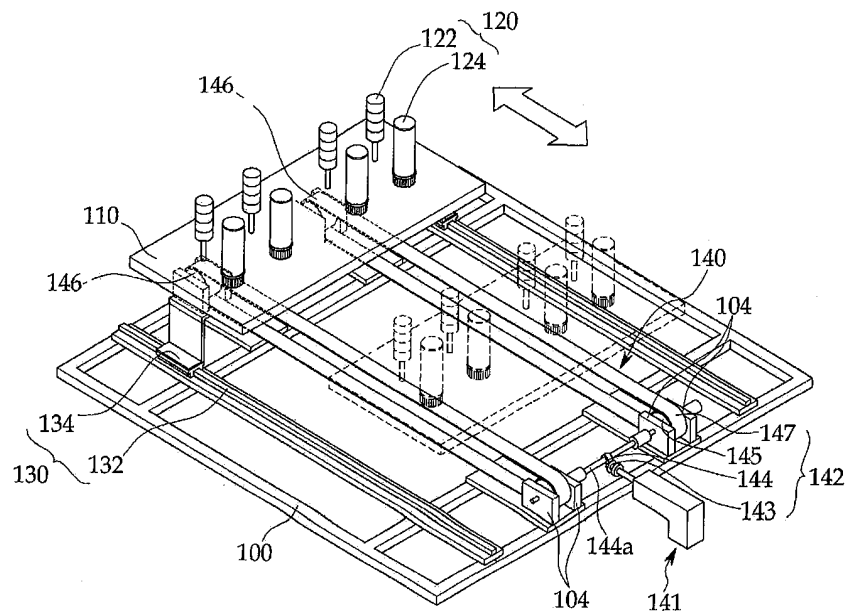


FIG. 2

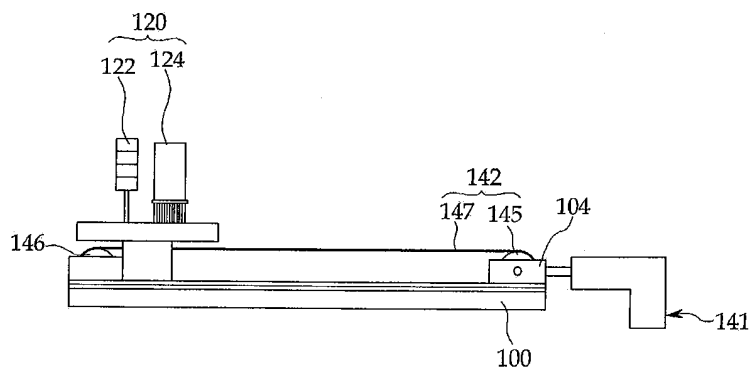
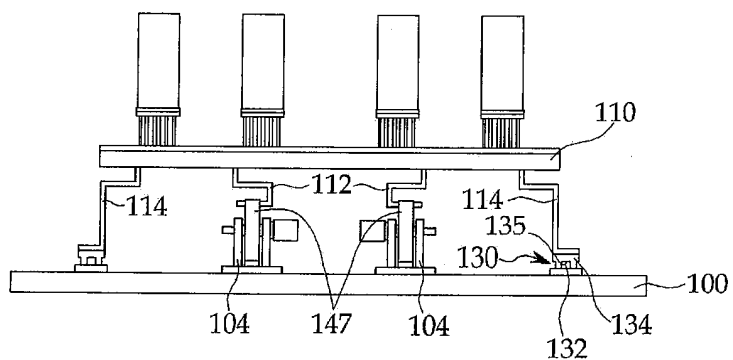


FIG. 3



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FIG. 4

