11 can be appropriately increased and decreased in accordance with the scale of culture.

The shape of a cross section of a tubular portion 11 is preferably circular, but may be elliptic or may not be completely circular.

[0024] The cell culture bag 10 has a plurality of communication portions 12 which allow communication between two mutually adjacent tubular portions 11 of the plurality of tubular portions 11 in an intermediate region R of the tubular portions 11. The intermediate region R is a region between one end and the other end of a tubular portion 11 in the tube axis direction. More specifically, the plurality of communication portions 12 are provided between two mutually adjacent tubular portions 11 along the tube axis direction (Y-axis direction) of the tubular portions 11 for each pair consisting of the two mutually adjacent tubular portions 11. In the example shown in Fig. 1, three communication portions 12 are provided at different positions between the two mutually adjacent tubular portions 11 in the Y-axis direction. However, at least one communication portion 12 may be provided between the two mutually adjacent tubular portions 11 along the tube axis direction (Y-axis direction).

The shape of a cross section of a communication portion 12 is preferably circular, but may be elliptic or may not be completely circular.

[0025] In the present embodiment, the positions of the three communication portions 12, which are provided between the two mutually adjacent tubular portions 11 along the Y-axis direction, in the Y-axis direction are arranged between pairs each consisting of the two mutually adjacent tubular portions 11. That is, the communication portions 12 are disposed at positions Y_1, Y_2, and Y_3 in the Y-axis direction so as to penetrate a plurality of tubular portions 11 in a straight line in the X-axis direction. In addition, in the present embodiment, diameters D_1 of the plurality of tubular portions 11 are the same as each other and diameters D_2 of the communication portions 12 are designed to be the same as the diameters D_1 of the tubular portions 11. The diameters D_1 of the tubular portions 11 and the diameters D_2 of the communication portions 12 are preferably 5 mm to 50 mm. In a case where the diameters D_1 of the tubular portions 11 and the diameters D_2 of the communication portions 12 are less than or equal to 50 mm, it is possible to sufficiently supply gas to a central portion of the tubular portions 11 and the communication portions 12 in a radial direction. In contrast, in a case where the diameters D_1 of the tubular portions 11 and the diameters D_2 of the communication portions 12 are set to be greater than or equal to 5 mm, circulation of a culture solution and a cell suspension stored in the cell culture bag 10 is secured, and therefore, it is possible to maintain

culture bag 10 is used in a "vertical position" to be described below, the length of the tubular portion 11 in the tube axis direction (Y-axis direction) is preferably less than or equal to 1000 mm. In a case where the length thereof is less than or equal to 1000 mm, it is possible to produce the cell culture bag 10 without joining the cell culture bag in the tube axis direction and to produce the cell culture bag so as to prevent withstanding pressure of films from being insufficient with respect to pressure of a culture solution. In contrast, the length of a tubular portion 11 in a direction (X-axis direction) orthogonal to the tube axis direction, that is, in a direction in which a plurality of tubular portions 11 are arranged can be appropriately set in accordance with the scale of culture and can be set to, for example, 1000 mm to 1500 mm.

[0031] Hereinafter, an embodiment of a cell culture method according to the embodiment of the present invention using the cell culture bag 10 will be described.

[0032] A culture solution which can be applied to the cell culture method according to the embodiment of the present invention is not particularly limited and all culture solution can be applied. Specific examples thereof include liquid media such as a base medium for mammalian cells (for example, DMEM, DMEM/F-12, MEM, DME, RPMI1640, MCDB104, 199, MCDB153, L15, SkBM, Basal Medium, or E8 base medium), a commercially available culture solution for maintaining stem cells, a base medium for insect cells, a medium for yeast, and a medium for bacteria.

[0033] Polymer compounds without cytotoxicity may be added to the culture solution which can be applied to the cell culture method according to the embodiment of the present invention for the purpose of continuously floating cells and/or the purpose of preventing cells from being closely attached to each other. Examples of the polymer compounds added to the culture solution for the above-described purposes include a polymer compound that adjusts a specific gravity of a culture solution, a polymer compound that adjusts viscosity of a culture solution, and polymer compounds that form a three-dimensional network structure in a culture solution. Examples of such polymers include polysaccharides such as cellulose, methylcellulose, carboxymethyl cellulose, gellan gum, deacylated gellan gum, hyaluronic acid, alginic acid, carrageenan, xanthan gum, diutan gum, starch, and pectin; proteins such as collagen and gelatin; synthetic polymers such as polyethylene glycol and polyvinyl pyrrolidone.

[0034] Various types of generally addable components, for example, antibiotics such as penicillin and streptomycin; vitamins or vitamin derivatives such as ascorbic acid and retinoic acid; sugar sources such as glucose; amino acids; mineral salts; serum or serum substitutes;

For example, the positions of the communication portions 12 in the Y-axis direction may not be aligned between pairs each consisting of two mutually adjacent tubular portions 11 as in cell culture bags 10B and 10C shown in Figs. 8 and 9. Even in this case, it is possible to make a cell suspension and a culture solution mutually circulate between a plurality of tubular portions 11, and therefore, it is possible to secure homogeneity of the culture environment. In addition, by making diameters D_2 of the communication portions 12 be larger than diameters D_1 of the tubular portions 11 as in the cell culture bag 10C shown in Fig. 9, it is possible to promote the mutual circulation of the cell suspension and the culture solution between the plurality of tubular portions 11 and to make the capacity of the cell culture bag 10C be larger than that of the cell culture bag 10.

[0062] In addition, the above-described cell culture bag 10 (refer to Fig. 1) has the ports 16A and 16B on both one end side and the other end side of a tubular portion 11 in the tube axis direction. However, the present invention is not limited to this embodiment. Only a port 16B may be provided on one end side of a tubular portion 11 in the tube axis direction as in a cell culture bag 10D shown in Fig. 10. The cell culture bag 10D is provided such that the port 16B is positioned on the lower side in the vertical direction and injection, discharge, and the like of a cell suspension and a culture solution are performed through the port 16B during cell culture. In this manner, it is possible to simplify the configuration compared to that of the above-described cell culture bag 10 by providing only the port 16B on one end side of the tubular portion 11 in the tube axis direction. In contrast, according to the cell culture bag 10, it is possible to perform injection, discharge, and the like of a cell suspension and a culture solution through the ports 16A and 16B on the upper side and the lower side in the vertical direction, and therefore, it is possible to improve flexibility of design of an injection passage and a discharge passage of the cell suspension and the culture solution. The port 16B may be disposed in an intermediate region between one end and the other end of the tubular portion 11.

[0063] In addition, the ports 16A and 16B in the above-described cell culture bag 10 (refer to Fig. 1) are inserted into the bag main body from one end side in the X-axis direction. However, the present invention is not limited to this embodiment. For example, ports 16D, 16E, and 16F may be inserted into the bag main body from one end side in the Y-axis direction and ports 16G, 16H, and 16I may be inserted into the bag main body from the other side in the Y-axis direction as in a cell culture bag 10E shown in Fig. 11. In addition, a plurality of ports

16A to 16L may be inserted into the bag main body from one end side and the other end side in the Y-axis direction, one end side and the other end side in the X-axis direction, and corner portions of a cell culture bag 10F as in, for example, the cell culture bag 10F shown in Fig. 12. The ports 16A to 16L can be appropriately used for applications, for example, injection and discharge of a cell suspension and a culture solution, air ventilation within the cell culture bag 10F, and extraction of cells during culture. It is possible to reduce a risk of contamination by providing a plurality of ports 16A to 16L as in the cell culture bags 10E and 10F shown in Figs. 11 and 12 and assigning specific applications thereto.

[0064] In addition, the width of a through hole 18 (the length in the X-axis direction) may be changed along the tube axis direction (Y-axis direction) of a tubular portion 11 as in cell culture bags 10G and 10H shown in Figs. 13 and 14. In other words, the width of a seal portion 14 in the X-axis direction which is positioned on the lower side in the vertical direction may be made to be wider than that of the seal portion 14 in the X-axis direction which is positioned on the upper side in the vertical direction. For example, the width of a seal portion 14 positioned at the lowermost portion may be enlarged downward in the vertical direction by setting the shape of a through hole 18 formed in the seal portion 14 positioned at the lowermost portion to an inverse triangular shape as shown in Fig. 13. The width of the through hole 18 formed in the seal portion 14 positioned at the lowermost portion may be set to be narrower than that of the through hole 18 formed in the seal portion 14 positioned at the upper portion as shown in Fig. 14. The pressure applied to the seal portion 14 during cell culture becomes large downward in the vertical direction. Therefore, it is possible to increase withstanding pressure of the seal portion 14 positioned on the lower side in the vertical direction by enlarging the width of the seal portion 14 positioned on the lower side in the vertical direction. The width of only the seal portion 14 positioned at the lowermost portion is enlarged in Figs. 13 and 14. However, the width of a seal portion 14 in an upper portion from the lowermost portion may also be similarly enlarged.

[0065] The cell culture bags 10 and 10A to 10H are examples of the cell culture bag in the present invention. The tubular portion 11 is an example of the tubular portion in the present invention. The communication portion 12 is an example of the communication portion in the present invention. The seal portions 13 and 14 are examples of the seal portions in the present invention. The through holes 15 and 18 are examples of the through holes in the present invention. The ports 16A and 16B are examples of the ports in the present invention.