

Title of Invention: SAFETY CABINET FOR KEEPING ANIMAL

Technical Field

[0001]

The present invention relates to biological safety cabinets for animal cages for keeping infected animals infected with a specific pathogen in a device for research of infectious diseases and development of pharmaceuticals.

Background Art

[0002]

Biological safety cabinets for animal cages are used for keeping animals infected with pathogens in a work space of a device, and when the kept animals are to be fed, front windows/sashes formed on a front surface of the work space where the animals are kept are opened, and feeding or the like is accomplished through the opening portion. By sucking air through the opening portion formed on the front windows/sashes portion into the biological safety cabinet for animal cages, an air barrier is generated in the opening portion, and infectious substances in the work space are prevented from leaking out of the biological safety cabinet for animal cages. The air barrier generated at this opening portion is kept at an average air velocity of 0.5 m/s or more and isolates the work space from an environment outside of the biological safety cabinet for animal cages. The air sucked through the opening portion of the front windows/sashes portion flows through the biological safety cabinet for animal cages and is filtered to remove dusts and infectious substances in the work space by a High Efficiency Particulate Air Filter for discharge arranged in the biological safety cabinet for animal cages, and only the air is discharged to the outside of the biological safety cabinet for animal cages. This discharged air is discharged to the outside of a room in which the biological safety cabinet for animal cages is installed through a duct connected to an outlet of the biological safety cabinet for animal cages.

[0003]

The biological safety cabinet for animal cages according to a prior-art technology is disclosed in Japanese Patent No. 4502222. A cage for keeping animals is arranged in a work space, and feeding or the like for the kept animals is accomplished through a work access opening formed in a lower part of the front windows/sashes. It is configured such that infectious substances having infected the animals do not leak out of the biological safety cabinet for animal cages by a sucked air-flow air barrier formed at the work access opening.

Citation List

Patent Literature

[0004]

Patent Literature 1: Japanese Patent No. 4502222

Summary of Invention

Technical Problem

[0005]

In the above described prior-art biological safety cabinets for animal cages, the cage for keeping animals is arranged in the work space as illustrated in Japanese patent No. 4502222. A configuration for the air flow is such that the air sucked through the work access opening formed in the lower part of the front windows/sashes flows into the work space, is sucked through a front suction port formed on a lower surface of the work space, flows through a rear surface of the work space and is sucked into a blower. A part of the air sucked into the blower is filtered to remove dusts and infectious substances by the HEPA filter arranged on an upper part of the work space, and only clean air is supplied to the work space. The other part of the air is filtered to remove dusts and infectious substances by the HEPA filter for discharge and is emitted as clean air to the outside of the biological safety cabinet. An air amount sucked through the work access opening is equal to an air amount discharged from the biological safety cabinet for animal cages.

[0006]

As described above, an air barrier for isolating the work space from a space outside of the biological safety cabinet for animal cages is formed by the air sucked through the work access opening. This isolating performance requires air-flow balance performance "Personnel protection" test performances described in Japanese Industrial Standard JIS K3800. In order to maintain this "Personnel protection" test performances, an average inflow air velocity at 0.5 m/s or more of the air flowing in through the work access opening needs to be ensured. Since the work access opening is formed below the front windows/sashes formed in a width direction of the work space, the air amount flowing in through the work access opening becomes an air amount of a width dimension $\times$ work access opening height $\times$ 0.5 m/s or more of the work space. In general, the work access opening height is a dimension of approximately 200 to 250 mm capable of performing a feeding work and also capable of ensuring the isolating performance by the air barrier. In the case of the work access opening dimension of 200 mm and the width dimension of the work space of 1 m, the air amount of $1 \text{ m} \times 0.2 \text{ m} \times 0.5 \text{ m/s} \times 60 \text{ seconds} = 6 \text{ m}^3/\text{min}$ or more is needed. The air amount flowing in through the work access opening is in proportion to the width dimension of the work space and the air amount becomes larger as the width dimension increases. The air amount flowing in through the work access opening is equal to the air amount discharged from the biological safety cabinet for animal cages, and if the discharged air from the biological safety cabinet for animal cages is discharged not in the room in which the

biological safety cabinet for animal cages is installed but to the outdoor by connecting a duct, a discharged air amount becomes a load to an indoor air-conditioning.

[0007]

However, while the animals are kept without being fed, there is no need to open the work access opening, and the front windows/sashes are closed for keeping the animals. When the front windows/sashes are closed, the air amount flowing in through the work access opening becomes small, and the discharged air amount of the biological safety cabinet for animal cages can be also made small.

[0008]

As described above, in the prior-art biological safety cabinet for animal cages, the discharged air amount of the biological safety cabinet for animal cages needs to be controlled separately for the feeding work and the other times.

[0009]

Moreover, since the prior-art biological safety cabinet for animal cages has a large discharged air amount during the feeding work, the air-conditioning load tends to be larger.

[0010]

On the basis of the above described problems of the prior art technology, an object of the present invention is to provide a biological safety cabinet for animal cages which minimizes an air amount for maintaining isolating performances between the work space and the outside of the biological safety cabinet and does not require control of a change of the air amount during the feeding work and the other times when an infectious animal is kept.

Solution to Problem

[0011]

In order to solve the above problem, the present invention configures a device as follows.

[0012]

A biological safety cabinet for animal cages of the present invention is, in a biological safety cabinet for animal cages having an air discharge system for discharging air from a work space to the outside of a device through first air cleaning means by blower means and a front-surface door formed on a front surface of the work space, an air supply system for supplying the air to the work space through second air cleaning means and a small window capable of being opened/closed and formed in the work space are provided, the blower means forms an air flow in series with the first and second air cleaning means, and when the small window is closed, the air is sucked from the second air cleaning means, while when the small window is open, the air is sucked from an opening portion of this small window.

[0013]

Moreover, in the biological safety cabinet for animal cages of the present invention, a flow of the air is formed in series with the first and second air cleaning means by the blower means.

[0014]

Moreover, in the biological safety cabinet for animal cages of the present invention, a wall surface of the work space in which the small window is formed or the front surface door is formed with a double structure, and an opening portion larger than an opening area of the small window is formed on a side of the work space of the double-structured wall surface.

[0015]

Moreover, in the biological safety cabinet for animal cages of the present invention, the air is supplied to the second air cleaning means by second blower means.

[0016]

Moreover, in the biological safety cabinet for animal cages of the present invention, by opening the small window, an average inflow air velocity of 0.5 m/s or more of a sucked air flow of a small-window opening portion generated in the small-window opening portion is ensured.

Advantageous Effects of Invention

[0017]

In the biological safety cabinet for animal cages of the present invention, in a normal keeping state in which the small window is closed, an air outside the biological safety cabinet for animal cages is sucked from the second air cleaning means by a negative pressure of the work space. On the other hand, in a state in which the feeding work is performed with the small window open, since a pressure loss of the small-window opening portion is smaller than the pressure loss of the second air cleaning means, the air is sucked not from the second air cleaning means but from the small-window opening portion, and a sucked air flow of the small-window opening portion is generated. Since this phenomenon occurs only by a difference in the pressure losses, air-amount control of the blower is not required and thus, the infectious substances in the work space 3 is prevented by a small air amount from leaking out of the small-window opening portion, and since only a spot where the air is sucked into the work space is changed while the air amount of the blower is kept constant, the entire discharge system including a discharge duct can be configured relatively inexpensively. Moreover, in keeping infected animals, the isolating performances between an inside of the work space and the outside for preventing infection can be maintained with the same discharged air amount both during the feeding work requiring an opening portion for feeding and the other times not requiring the opening portion.

Brief Description of Drawings

[0018]

[FIG. 1A] FIG. 1A is a sectional structural view of a biological safety cabinet for animal cages illustrating Embodiment 1 of the present invention.

[FIG. 1B] FIG. 1B is a sectional structural view of the biological safety cabinet for animal cages illustrating Embodiment 1 of the present invention and is an A-A sectional view of FIG. 1A.

[FIG. 2A] FIG. 2A is a sectional structural view of the biological safety cabinet for animal cages illustrating Embodiment 1 of the present invention.

[FIG. 2B] FIG. 2B is an appearance view of the biological safety cabinet for animal cages illustrating Embodiment 1 of the present invention.

[FIG. 3A] FIG. 3A is a sectional structural view of a state in which a small window of the biological safety cabinet for animal cages illustrating Embodiment 1 of the present invention is closed.

[FIG. 3B] FIG. 3B is a sectional structural view of a state in which a small window of the biological safety cabinet for animal cages illustrating Embodiment 1 of the present invention is open.

[FIG. 4A] FIG. 4A is a sectional structural view of a biological safety cabinet for animal cages illustrating Embodiment 2 of the present invention.

[FIG. 4B] FIG. 4B is an appearance view of the biological safety cabinet for animal cages illustrating Embodiment 2 of the present invention.

[FIG. 5A] FIG. 5A is a sectional structural view of a state in which a small window of the biological safety cabinet for animal cages illustrating Embodiment 2 of the present invention is closed.

[FIG. 5B] FIG. 5B is a sectional structural view of a state in which a small window of the biological safety cabinet for animal cages illustrating Embodiment 2 of the present invention is open.

[FIG. 6A] FIG. 6A is a sectional structural view of a biological safety cabinet for animal cages illustrating Embodiment 3 of the present invention.

[FIG. 6B] FIG. 6B is an appearance view of the biological safety cabinet for animal cages illustrating Embodiment 3 of the present invention.

Description of Embodiments

[0019]

Embodiments of the present invention will be described below by referring to FIGS. 1A to 6B.

Embodiment 1

[0020]

FIGS. 1A and 1B are sectional structural views of a biological safety cabinet for animal cages illustrating Embodiment 1 of the present invention.

[0021]

FIGS. 2A and 2B are a sectional structural view and an appearance view of the biological safety cabinet for animal cages illustrating Embodiment 1 of the present invention.

[0022]

An air flow of the biological safety cabinet 1 for animal cages is configured such that a sucked air 13 sucked from second air cleaning means 12b is filtered to remove dusts outside the biological safety cabinet 1 for animal cages, flows through a rectifying plate 16, becomes a blown-out air 15 (in work chamber), and is supplied to a work space 3. An infected animal 20 is kept in this work space 3. The air (blown-out air 15) flowing into the work space 3 branches and is sucked to a front-surface suction port 17 and a rear-surface suction port 18, flows through a rear-surface channel 19, is filtered to remove dusts and an infectious substance 10 by first air cleaning means 12a, is sucked into a blower 5a, and is discharged as a discharged air 9 from the biological safety cabinet 1 for animal cages. Here, as the first air cleaning means 12a, an HEPA filter or the like is used for removing fine substances such as the infectious substance 10. As the second air cleaning means 12b, an unwoven cloth filter for removing only coarse dusts and an HEPA filter for removing fine dusts can be used depending on an application of an animal to be kept for the air to be supplied into the space 3 in which the kept animal 20 is present.

[0023]

In the Embodiment 1 (FIGS. 1A to 3B), since the air flow from the second air cleaning means 12b to the first air cleaning means 12a is constituted by the blower 5a, all the air is sucked, whereby a pressure inside the work space 3 becomes negative. Since a pressure in the work space 3 becomes a negative pressure, the infectious substance 10 in the work space 3 does not leak out of the biological safety cabinet 1 for animal cages.

[0024]

A device of this Embodiment 1 is configured such that an animal cage 23 is arranged on a work table 2 on a lower surface of the work space 3, and the kept animal 20 is kept in the animal cage 23. There is a drain 26 below the work table 2, a tray 25 is arranged on the drain 26, and a filth sheet 24 is arranged on the tray 25. As a result, a filth 21 excreted by the kept animal 20 drops onto the filth sheet 24, and by collecting the filth sheet 24, the inside of the drain 26 can be cleaned. A method of collecting the filth sheet 24 is such that a tray collecting cover 27 is opened, the tray 25 is withdrawn, and the filth sheet 24 is collected together with the tray 25 and thus, the filth 21 is not directly touched when the filth 21 is collected.

[0025]

When the tray 25 is collected, by putting a vinyl bag (not shown) at the opening portion where the tray collecting cover 27 is opened, the tray 25 with the filth 21 thereon can be wrapped and collected from above the vinyl bag. This is a so-called bag-in/bag-out collecting method.

[0026]

When the filth sheet 24 is not used, a feed-water inlet (not shown) capable of feeding water to the drain 26 is provided, and the filth is flushed by making a liquid flow to a water outlet (not shown) provided on the drain 26 and collected. By flushing and catching the filth by the liquid, the filth can be collected without directly touching the filth 21.

[0027]

On a front surface of the work space 3, a front-surface door 4 is formed. The front-surface door 4 is attached to a main body case 1a by a hinge 28a and can be opened/closed. By opening/closing the front-surface door 4, the animal cage 23 is put into/out of the work space 3. Once the kept animal 20 is placed in the biological safety cabinet 1 for animal cages for keeping, a frequency of putting the kept animal 20 into/out of the biological safety cabinet 1 for animal cages is extremely lower than the frequency of performing the feeding work.

[0028]

Thus, an opening portion is formed at a part of the front-surface door 4, and a small window 6 is formed at the opening portion. The small window 6 is attached to the front-surface door 4 by a hinge 28b so that the small window 6 can be opened/closed. When a plurality of the biological safety cabinets 1 for animal cages are juxtaposed for keeping animals, spots to access the animals are limited to the front surfaces. Thus, arrangement of the small window 6 on the front-surface door 4 arranged on the front surface of the work space 3 improves efficiency of arrangement of the biological safety cabinets 1 for animal cages. However, if an inner side of the small window 6 is close to the work space 3, the small window 6 may be formed not on the front-surface door 4 on the front surface but on a side surface of the biological safety cabinet 1 for animal cages, for example.

[0029]

In the biological safety cabinet 1 for animal cages, when the first air cleaning means 12a such as the HEPA filter is to be replaced, it is necessary to open the cover 33 and to replace the first air cleaning means 12a. This replacement work is performed when the first air cleaning means 12a is clogged, whereby air does not flow easily, and when the first air cleaning means 12a can no longer remove dusts due to breakage or the like, and such a case occurs extremely rarely.

[0030]

FIGS. 3A and 3B are sectional structural views of a state in which the small window 6 of the biological safety cabinet 1 for animal cages is opened/closed illustrating Embodiment 1 of the present invention.

[0031]

That is, FIG. 3A illustrates a state in which the small window 6 is closed, and FIG. 3B illustrates a state in which the small window 6 is opened for giving water or a feed to the kept animal 20.

[0032]

In the biological safety cabinet 1 for animal cages in Embodiment 1 as above, in a normal keeping state (FIG. 3A) in which the small window 6 is closed, the air outside the biological safety cabinet 1 for animal cages is sucked through the second air cleaning means 12b by the negative pressure in the work space 3. Moreover, in the state in which the feeding work is performed by opening the small window 6 (FIG. 3B), since the pressure loss of a small-window opening portion 7 is smaller than the pressure loss of the second air cleaning means 12b, when the small window 6 is opened, the outside air is sucked not from the second air cleaning means 12b but from the small-window opening portion 7. At this time, the above described the air flow of the blown-out air 15 (in work chamber) is gone, and a sucked air flow 14 in the small-window opening portion is generated. Since this phenomenon occurs only by the difference in the pressure loss between the both, air amount control of the blower 5a is not needed.

[0033]

By providing the small window 6 as above, the sucked air flow 14 in the small-window opening portion is generated in the small-window opening portion 7. At this time, in order to ensure an air barrier, assuming that an average inflow air velocity of the sucked air flow 14 in the small-window opening portion at 0.5 m/s or more is ensured, and the small-window opening portion 7 is 0.2 m × 0.3 m, an air amount of $0.2 \text{ m} \times 0.3 \text{ m} \times 0.5 \text{ m/s} \times 60 \text{ seconds} = 1.8 \text{ m}^3/\text{min}$ or more is needed. This value is an air amount of 1/3 or less of 6 m³/min of a prior-art example. Leakage of the infectious substance 10 in the work space 3 out of the small-window opening portion 7 is prevented by a small air amount as above, and since only the spot where the air is sucked into the work space 3 is changed while the air amount of the blower 5a is kept constant, the entire system of the discharge system including the discharge duct can be configured relatively inexpensively.

[0034]

As described above, in Embodiment 1, by ensuring the average inflow air velocity at 0.5 m/s or more with a simple configuration, the air flow balance performance "Personnel protection" test performances described in Japanese Industrial Standard JIS K3800 are ensured, and the infectious substance 10 can be prevented from leaking out of the biological safety cabinet 1 for animal cages.

[0035]

Moreover, if prevention of leakage of an aerosol of the infectious substance 10 generated from the filth 21 or the dried filth 21 containing the infectious substance 10 out of the biological safety cabinet 1 for animal cages is considered not only during the feeding work but also when the tray collecting cover 27 is opened, an opening area of a portion where the tray collecting cover 27 is opened is considered, and by operating with the discharged air amount which can ensure the average inflow air velocity at 0.5 m/s or more by the small-window opening portion 7 and the opening portion with a large area of the portion where the tray collecting cover 27 is opened, when the small window 6 is opened, an air barrier is generated in the small-window

opening portion 7, while when the tray collecting cover 27 is opened, the air barrier is generated in the portion where the tray collecting cover 27 is opened, whereby leakage of the infectious substance 10 out of the biological safety cabinet 1 for animal cages can be prevented.

Embodiment 2

[0036]

FIGS. 4A and 4B are a sectional structural view and an appearance view of a biological safety cabinet for animal cages illustrating Embodiment 2 of the present invention.

[0037]

In the biological safety cabinet 1 for animal cages in Embodiment 2, the front-surface door is made as a double door 29. The double door 29 is formed of an inner window 30a and an outer window 30b, and a double-door internal space 32 is formed between the inner window 30a and the outer window 30b. In the inner window 30a, an inner-window opening portion 31 is formed so as to connect the double-door internal space 32 to the work space 3.

[0038]

FIGS. 5A and 5B are sectional structural views of a state in which a small window of the biological safety cabinet 1 for animal cages is opened/closed illustrating Embodiment 2 of the present invention.

[0039]

FIG. 5A illustrates a state in which the small window 6 is closed, and FIG. 5B illustrates a state when water or a feed is given to the kept animal 20 with the small window 6 open.

[0040]

Similarly to FIG. 3A, in the normal kept state (FIG. 5A) in which the small window 6 is closed, an air outside the biological safety cabinet 1 for animal cages is sucked from the second air cleaning means 12b by a negative pressure of the work space 3. In a state in which the feeding work is performed with the small window 6 open (FIG. 5B), since the pressure loss of the small-window opening portion 7 is smaller than the pressure loss of the second air cleaning means 12b, the air is sucked not from the second air cleaning means 12b but from the small-window opening portion 7. At this time, the air flow of the blown-out air 15 (in work chamber) is gone, and the sucked air flow 14 in the small-window opening portion is generated. Since this phenomenon occurs only by the difference in the pressure loss between the second air cleaning means 12b and the small-window opening portion 7, air amount control of the blower 5a is not needed.

[0041]

What is different from FIG. 3A is that the double door 29 has the double-door internal space 32, and the small-window opening portion 7 and the inner-window opening portion 31 are formed in the inner window 30a. Water and a feed are given to the kept animal 20 through the small-window opening portion 7.

[0042]

In the biological safety cabinet 1 for animal cages of Embodiment 2, the opening area of the inner-window opening portion 31 is formed larger than the small-window opening portion 7. As a result, the air in the double-door internal space 32 can easily flow out of the inner-window opening portion 31 into the drain 26 rather than out of the small-window opening portion 7. By means of this configuration, the sucked air flow 14 in the small-window opening portion passes through the double-door internal space 32 before directly entering the work space 3 from the small-window opening portion 7, passes the drain 26 below the kept animal 20, the rear surface channel 19, and the first air cleaning means 12a from the inner-window opening portion 31 and is discharged from the blower 5a to the outside of the biological safety cabinet 1 for animal cages.

By means of this air-flow configuration, it becomes less likely that the air containing dusts outside the biological safety cabinet 1 for animal cages directly enters the work space 3 from the small-window opening portion 7 and thus, it is effective if dusts in a peripheral environment outside the biological safety cabinet 1 for animal cages should be considered for the kept animal 20.

Embodiment 3

[0043]

FIGS. 6A and 6B are sectional structural view and an appearance view of a biological safety cabinet 1 for animal cages illustrating Embodiment 3 of the present invention.

[0044]

In Embodiments 1 and 2, the blower 5a is arranged only on the first air cleaning means 12a side, but in Embodiment 3, a second blower 5b is arranged also on the second air cleaning means 12b side.

[0045]

This is effective if the pressure loss of the second air cleaning means 12b is large or if the pressure loss of the air cleaning means configured in a double structure of the first air cleaning means 12a and the second air cleaning means 12b cannot be made up for only by one unit of the blower 5a. However, it is necessary to operate the pressure in the work space 3 with a negative pressure even if the second blower 5b is operated.

[0046]

In keeping of infectious animals in each of the above described embodiments, the isolating performances between the inside and outside of the work space for prevention of infection can be maintained by the same discharged air amount both during the feeding work requiring an opening portion for feeding and in the other times when the opening portion is not needed.

Reference Signs List

[0047]

- 1 biological safety cabinet for animal cages
- 1a main body case
- 2 work table
- 3 work space
- 4 front-surface door
- 5a blower
- 5b second blower
- 6 small window
- 7 small-window opening portion
- 8 air outlet
- 9 discharged air
- 10 infectious substance
- 11 inflow air flow
- 12a first air cleaning means
- 12b second air cleaning means
- 13 sucked air
- 14 sucked air flow in small-window opening portion
- 15 blown-out air (in work chamber)
- 16 rectifying plate
- 17 front-surface suction port
- 18 rear-surface suction port
- 19 rear-surface channel
- 20 kept animal
- 21 filth
- 22 worker
- 23 animal cage
- 24 filth sheet
- 25 tray
- 26 drain
- 27 tray collecting cover
- 28a hinge a
- 28b hinge b
- 29 double door
- 30a inner window
- 30b outer window
- 31 inner-window opening portion
- 32 double-door internal space
- 33 cover
- 34 suction inlet

[Claim 1]

A biological safety cabinet for animal cages having an air discharge system for discharging air from a work space to outside of a device through first air cleaning means by blower means and a front-surface door formed on a front surface of the work space, the biological safety cabinet comprising an air supply system for supplying the air to the work space through second air cleaning means and a small window capable of being opened/closed and formed on a wall surface of the work space including the front-surface door, wherein

the blower means forms an air flow in series with the first and second air cleaning means, and when the small window is closed, the air is sucked from the second air cleaning means, while when the small window is open, the air is sucked from an opening portion of the small window.

[Claim 2]

The biological safety cabinet for animal cages according to claim 1, wherein a flow of the air is formed in series with the first and second air cleaning means by the blower means.

[Claim 3]

The biological safety cabinet for animal cages according to claim 1 or 2, wherein

a wall surface of the work space in which the small window is formed or the front surface door is formed with a double structure, and an opening portion larger than an opening area of the small window is formed on a side of the work space of the double-structured wall surface.

[Claim 4]

The biological safety cabinet for animal cages according to claim 1 or 2, wherein

the air is supplied to the second air cleaning means by second blower means.

[Claim 5]

The biological safety cabinet for animal cages according to claim 3, wherein by opening the small window, an average inflow air velocity of 0.5 m/s or more of a sucked air flow of a small-window opening portion generated in the small-window opening portion is ensured.