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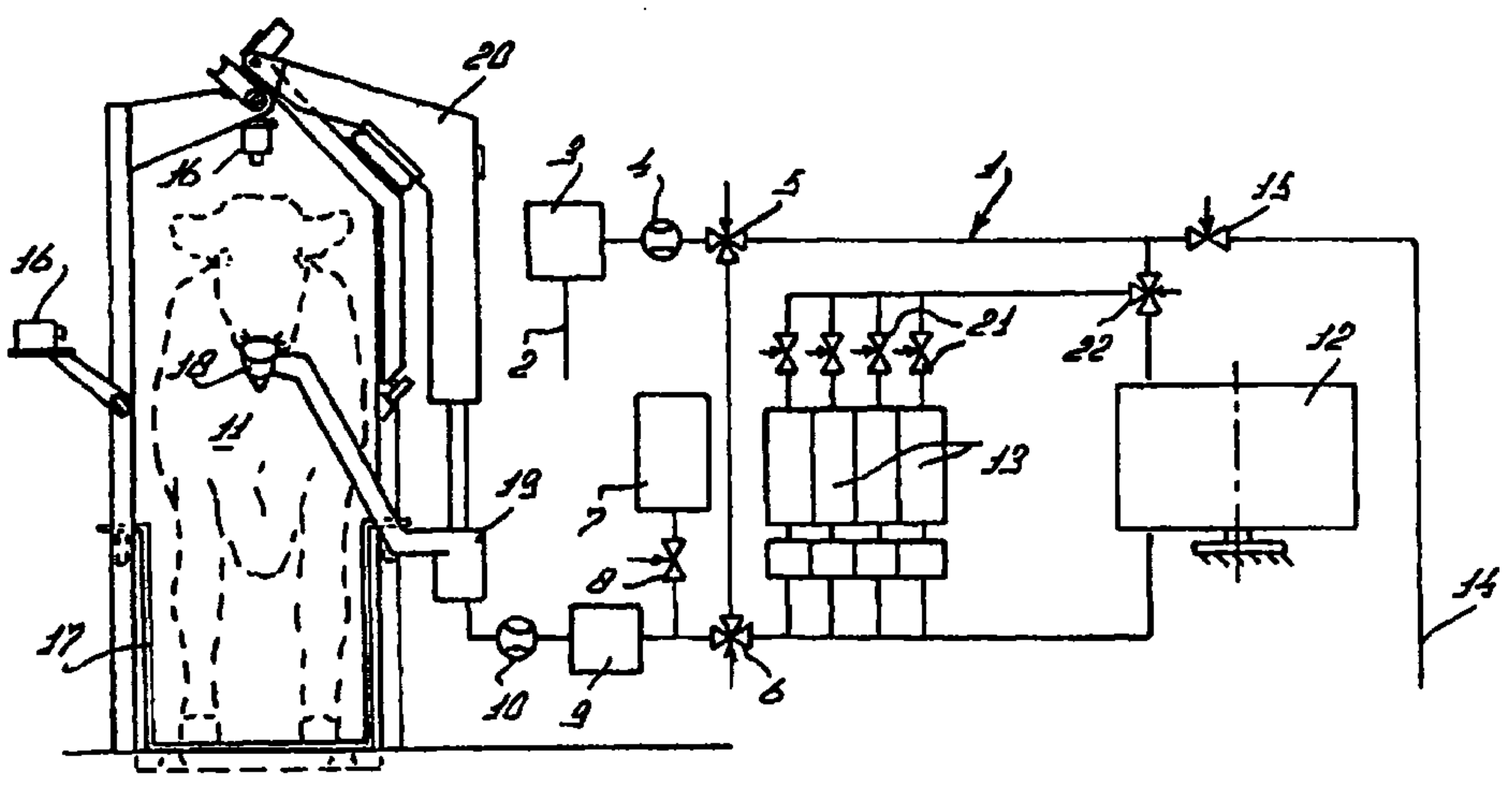
(54) **PROCEDE ET DISPOSITIF POUR L'ALIMENTATION AUTOMATIQUE D'ANIMAUX**

(54) **A METHOD OF AND AN IMPLEMENT FOR AUTOMATICALLY FEEDING ANIMALS**



(57) L'invention se rapporte à un procédé et à un dispositif pour l'alimentation automatique d'animaux, notamment de veaux. Dans ledit dispositif, la quantité d'aliment est régulée en fonction des exigences nutritionnelles de chaque animal et l'aliment est produit par une machine à traire.

(57) The invention relates to a method of and an implement for automatically feeding animals, such as calves, in which the amount of feed is attuned to the nutritive need of the individual animal and the feed is yielded by a milking machine.

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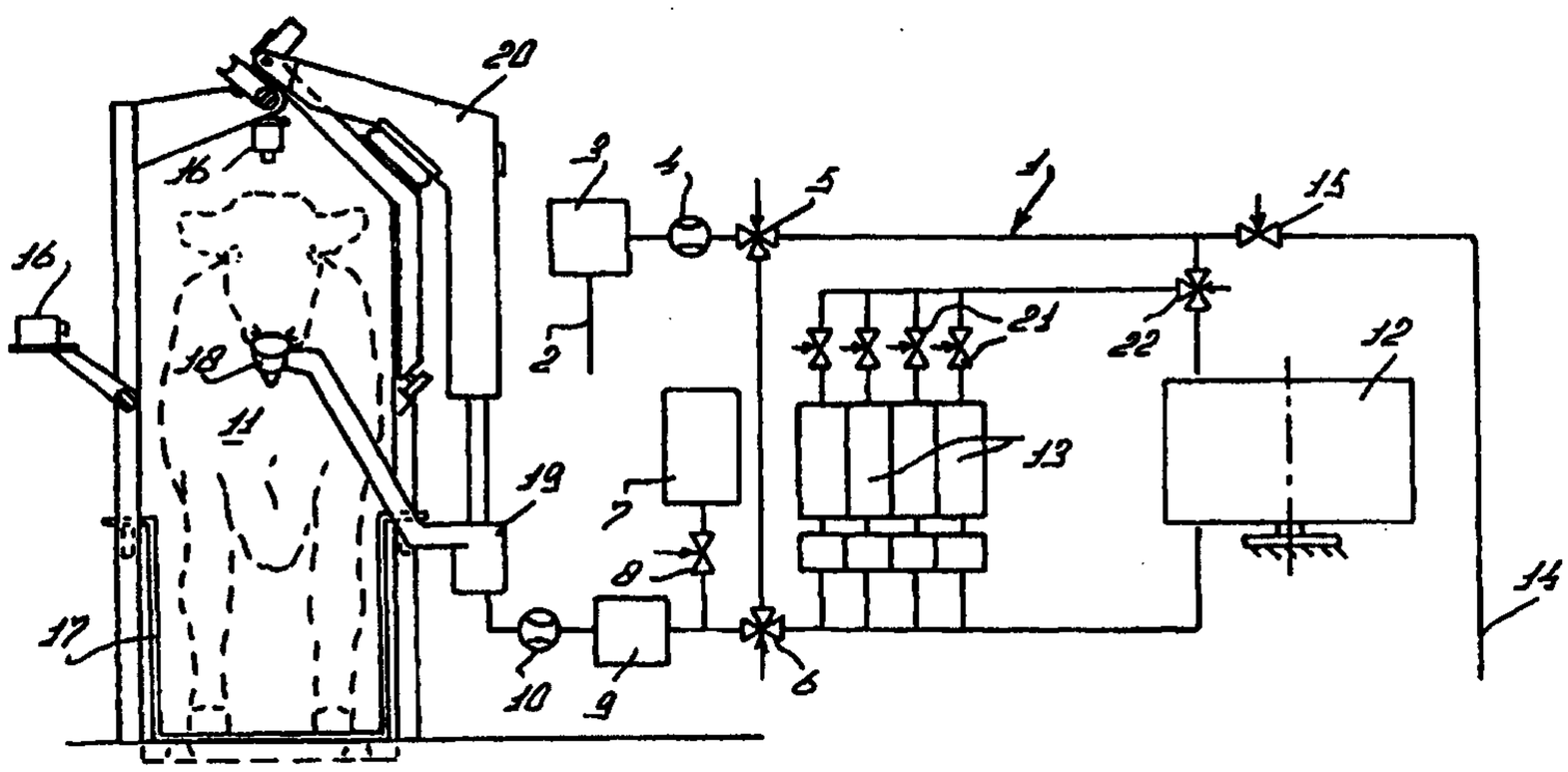


(57) Abstract

The invention relates to a method of and an implement for automatically feeding animals, such as calves, in which the amount of feed is attuned to the nutritive need of the individual animal and the feed is yielded by a milking machine.

A METHOD OF AND AN IMPLEMENT FOR AUTOMATICALLY FEEDING ANIMALS

The invention relates to a method of automatically feeding animals, such as calves or cows, in which milk or mother's milk, such as beestings, beestingslike milk, foremilk, or colostrum, is a component part of the feed, and in which the amount of feed is attuned to the nutritive need of the individual animal and the feed is supplied to the individual animal.

Such a method has the disadvantage that the milk or mother's milk is yielded manually from the mother cow or dairy animal and is subsequently supplied to the feeding machine for young animals. This is very labour-intensive, especially because the young animals often have to be provided with milk or mother's milk many times a day. It may also be advantageous to compose a special feed for certain animals, such as bulls that are used for artificial insemination (AI-bulls). Also in that case feeding is very labour-intensive.

The invention aims at obviating these drawbacks. For that purpose the milk or mother's milk is yielded by the milking machine and is supplied automatically and directly from the milking machine to the individual animal, or the milk or mother's milk is supplied automatically after having been stored in a first or further storage means. In this way it is no longer necessary to yield the milk or mother's milk manually and the milk is supplied automatically to the individual animal, such as a calf or an AI-bull.

According to another inventive feature, an individual animal is identified and the individual animal is

provided with feed, provided that a preset time has elapsed since the last feeding of this individual animal.

In accordance with an inventive feature, the composition of the feed is automatically attuned to the current nutritive requirements of the individual animal. The composition of the feed is automatically attuned to the current nutritive requirements of the individual animal by adding one or more auxiliary substances. The auxiliary substances that can be automatically added to the composition of the feed comprise inter alia water, vitamins, medicaments, nutritive supplements, immunological stimulants, or growth stimulants, such as hormones.

According to a further inventive feature, an automatic determination of the composition of the milk or mother's milk is effected and, on the basis of said determination, the milk or mother's milk yielded by the milking machine is automatically discharged or stored in a first or further storage means.

In accordance with another aspect of the invention, the milk or mother's milk yielded by the milking machine is cooled down and stored in a liquid or solid phase in a first or further storage means. When storing the milk or mother's milk, the characteristics and the composition of the milk or mother's milk are maintained as optimally as possible, while the milk or mother's milk is preserved at the same time.

According to again another aspect of the invention, one or more characteristics, such as an identification number, of the dairy animal, such as a cow or mother cow from which the milk or mother's milk has been yielded, are stored in a memory, and the milk or mother's milk from the dairy animal is supplied to the corresponding individual animal, such as a calf. In this manner it is possible for the individual animal to receive milk or mother's milk from its mother.

In accordance with an inventive feature, the current nutritive requirements of the individual animal are determined with the aid of automatic means and the composition of the feed is attuned to the current nutritive requirements of the individual animal. In this way it is

possible to provide the individual animal with special feed, for example when the animal is ill. According to a further inventive feature, the automatic means are adapted to determine the current nutritive requirements of the individual animal in an optical and/or acoustic manner, and/or on the basis of the animal's weight, and/or one or more dimensions of the individual animal. The data relating to the determination of the current nutritive requirements, nutritive need, the composition of the milk or mother's milk and the composition of the feed are stored in a memory. Suitable milk or mother's milk stored in the first or further storage means is selected on the basis of the data stored in a memory. Thus it is achieved that the individual animal is provided with milk or mother's milk which has been stored or supplied directly and whose composition corresponds to the current nutritive requirements of the individual animal.

The invention also relates to an implement for applying the above-mentioned methods, characterized in that the implement comprises a transport system for liquids and a metering device, and in that the implement comprises a feeding station for animals which is coupled to a milking machine. The transport system is adapted to supply the milk or mother's milk from the milking machine directly to a metering device, or the transport system is adapted to supply the milk or mother's milk to a metering device after the milk or mother's milk has been stored in a first or further storage means.

In accordance with another aspect of the invention, the implement comprises automatic means for determining the current nutritive requirements and nutritive need of the individual animal, which automatic means are adapted to measure the condition, and/or the growth, and/or the weight, and/or the blood pressure of the individual animal. The composition of the feed is attuned to the current nutritive requirements of the individual animal, which composition consists of milk and auxiliary substances or mother's milk and auxiliary substances and which composition corresponds to a previously adjusted composition of the feed, which previously adjusted composition is stored in a memory.

According to another characteristic of the invention, an algorithm calculates the previously adjusted composition of the feed for the individual animal on the basis of data stored in a memory, which data comprise values relating to the condition, growth and weight of the individual animal. A memory stores the values relating to the determination or calculation of the current nutritive requirements, and/or the nutritive need, and/or the composition of the milk or mother's milk and/or the composition of the feed.

According to a further inventive feature, the means adapted to measure the condition of the individual animal comprise a picture processing device and/or a colour sensor and/or an air sampling device and/or a sphygmomanometer and/or a temperature sensor. Such an air sampling device is known from EP 0 670 673 disclosing a device that collects air samples in the vicinity of an animal, analyses same and establishes with the aid thereof the animal's condition. The means adapted to measure the growth of the individual animal comprise acoustic or optical sensors, or a picture processing device. The means adapted to measure the weight of the individual animal comprise a pair of scales, strain gauges or piezo elements. The strain gauges or piezo elements may be fitted in the floor, so that the floor of the feeding station can be cleaned easily.

In accordance with again another aspect of the invention, the metering device is provided with a feeding trough and/or a drinking spout, such as a flexible nipple. According to another aspect of the invention, the metering device is provided with a temperature sensor. In a preferred embodiment of the invention, the metering device consists of a rubber nipple provided with a temperature sensor, so that the condition of the individual animal can be established.

According to another inventive feature, the implement is provided with an automatic mixing device adapted to add auxiliary substances to the milk or mother's milk, which auxiliary substances are attuned to the current nutritive requirements of the individual animal. For that purpose the automatic mixing device is provided with storage means for storing auxiliary substances such as water,

medicaments, vitamins, nutritive supplements, immunological stimulants, or growth stimulants, such as hormones.

In accordance with a further inventive feature, the transport system comprises computer controlled valves. According to again another inventive feature, the implement is provided with a first and a second volume flow meter. The first volume flow meter is suitable for measuring the amount of milk or mother's milk. This milk or mother's milk is yielded by the milking machine. The second volume flow meter is suitable for measuring the amount of feed supplied by the transport system to the metering device.

According to another aspect of the invention, the implement comprises an automatic analysis device adapted to perform measurements on the milk or mother's milk. The automatic analysis device is adapted to measure whether the milk or mother's milk is suitable for being supplied to an animal. The automatic analysis device is also adapted to measure the composition of the milk or mother's milk. According to another aspect of the invention, the automatic analysis device is adapted to store in a memory the amount and/or the composition of the milk or mother's milk and one or more characteristics of the dairy animal from which the milk or mother's milk has been yielded. The automatic analysis device is adapted to measure colour, cell count, hormones, germ count, nutritional value, contamination and concentration of antibiotics in the milk or mother's milk. The automatic analysis device is also adapted to apply DNA-analysis techniques, such as PCR and NASBA, to the milk or mother's milk. According to another inventive feature, the automatic analysis device is adapted to remove the milk or mother's milk or to supply same to a first or further storage means serving to supply the milk or mother's milk to the animal at a later point of time.

In accordance with again another inventive feature, the first storage means is provided with one or more reservoirs. According to another inventive feature, the first storage means is provided with coolers. The first storage means can also be provided with a temperature regulator. A memory is adapted to store the position of the milk or

mother's milk in the first storage means, one or more characteristics, such as an identification number, of the individual animal from which the milk or mother's milk has been yielded, and the composition and/or the amount of the milk or mother's milk. According to another inventive feature, the first storage means is adapted to store the milk or mother's milk in a liquid phase. According to again another aspect of the invention, one or more reservoirs are designed as refrigerated tanks. One or more reservoirs can also be designed as carousels and/or as sample racks. In this form the milk or mother's milk can easily be stored in separate reservoirs and be recollected.

According to a further inventive feature, the further storage means is provided with one or more reservoirs. The further storage means may be provided with coolers. According to another inventive feature, the further storage means is provided with a temperature regulator. According to again another inventive feature, a memory is adapted to store the position of the milk or mother's milk in the further storage means, one or more characteristics of the dairy animal from which the milk or mother's milk has been yielded, and the composition and/or the amount of the milk or mother's milk. According to a further inventive feature, the further storage means is adapted to store the milk or mother's milk in a solid phase. According to another inventive feature, one or more reservoirs are designed as freezing chambers or freezing-dry chambers. One or more reservoirs may also be designed as carousels and/or as sample racks.

In accordance with a further inventive feature, the implement comprises one or more temperature regulating means adapted to warm up the feed automatically, so that the feed is adapted to be consumed by the individual animal. According to a last inventive feature, the implement comprises means adapted to sterilize and/or pasteurize the feed automatically.

The invention will now be explained in further detail with reference to the drawing of an exemplary embodiment of an implement according to the invention.

Figure 1 is a view of an implement according to the

invention.

The embodiment of Figure 1 shows the implement. The implement is provided with a transport system 1 consisting, in a preferred embodiment, of a line system for the transport of milk or mother's milk, auxiliary substances and feed. The transport system is provided with automatic valves 8, 15, 21 and automatic three-way valves 5, 6, 22. From the inlet 2 the milk or mother's milk enters the implement from the milking machine which may consist of one or more milking robots. The milk or mother's milk is analysed by the automatic analysis device 3 measuring the composition of the milk or mother's milk. The results of the measurement of the composition together with the identification code of the mother cow are stored in a memory. The first volume flow meter 4 measures the amount of milk or mother's milk. This result is also stored in a memory together with the data from the automatic analysis device. Subsequently the milk or mother's milk can be supplied, via the three-way valve 5, automatically and directly to the individual animal 11, be stored in a first storage means 12 or a further storage means 13, or be discharged from the implement via a valve 15 and a discharge channel 14, for example to the sewer.

The storage of milk or mother's milk takes place in a first storage means 12 or a further storage means 13. In the first storage means 12 the milk or mother's milk is stored automatically, preferably in a liquid, cooled phase. The first storage means 12 is provided with separate reservoirs, so that the milk from different mother animals or dairy animals can be kept in the same storage means 12. In a memory are stored the composition of the milk or mother's milk, an identification code of the mother animal from which the milk or mother's milk has been yielded and the position of the milk or mother's milk in the first storage means 12. In a preferred embodiment of the invention, the first storage means 12 is designed as a sample rack or a carousel, so that in a relatively small space many milk samples can be kept separately and the samples can easily be stored in the first storage means 12 and be recollected therefrom. In the further storage means 13 the milk or mother's milk is stored

automatically, preferably in a solid, cooled phase. The milk or mother's milk can be frozen, but as a result thereof the composition of the milk or mother's milk may change. Therefore, in a preferred embodiment of the invention, the further storage means 13 consists of a freezing-dry chamber in which the milk or mother's milk is stored automatically, its composition remaining unchanged. Also in this case the further storage means 13 is provided with separate reservoirs, so that the milk from different mother animals can be kept in the same storage means 13. In a memory are stored the composition of the milk or mother's milk, an identification code of the mother animal from which the milk or mother's milk has been yielded and the position of the milk or mother's milk in the further storage means 13. In a preferred embodiment of the invention, the further storage means 13 is also designed as a sample rack or a carousel, so that in a relatively small space many milk samples can be kept separately and the samples can easily be stored in the further storage means 13 and be recollected therefrom.

Via the automatic three-way valve 6 the milk or mother's milk coming directly from the milking machine or first having been stored in a first storage means 12 or a further storage means 13, is then supplied to the individual animal 11, while a warming up element 9 first warms up the feed or the milk or mother's milk, so as to make the feed or the milk or mother's milk suitable for consumption by the young animal. The amount of feed supplied to the young animal is measured by means of a second volume flow meter 10.

When an animal enters the feeding station, it is identified automatically. The composition of the feed is adapted to the current nutritive need of the individual young animal. With the aid of the automatic mixing device 7 and the valve 8, auxiliary substances can be added to the milk or mother's milk, so that the feed is composed for the individual animal. The current nutritive need is determined by means of sensors, an algorithm and data relating to the condition, growth and weight of the individual animal, which data are stored in a memory. These sensors comprise in this embodiment: optical sensors 16 for measuring the condition

and growth of the animal, a weighing device 17 and a temperature sensor in the metering device 18.

Then the individual animal is fed by means of a metering device which, in this embodiment, is connected to a movable arm 19. Said movable arm may be connected to a pivotable arm 20.

CLAIMS

1. A method of automatically feeding animals, such as calves or cows, in which
- milk or mother's milk, such as beestings, beestingslike milk, foremilk, or colostrum, is a component part of the feed,
- the amount of feed is attuned to the nutritive need of the individual animal,
- the feed is supplied to the individual animal,

characterized in that
- the milk or mother's milk is yielded by a milking machine,
- the milk or mother's milk is supplied automatically and directly from the milking machine to the individual animal, or the milk or mother's milk is supplied automatically after having been stored in a first or further storage means.

2. A method as claimed in claim 1, characterized in that
- an individual animal is identified,
- the individual animal is provided with feed, provided that a preset time has elapsed since the last feeding of this individual animal.

3. A method as claimed in claim 1 or 2, characterized in that
- the composition of the feed is automatically attuned to the current nutritive requirements of the individual animal.

4. A method as claimed in any one of claims 1 - 3, characterized in that
- the composition of the feed is automatically attuned to the current nutritive requirements of the individual animal by adding one or more auxiliary substances.

5. A method as claimed in any one of claims 1 - 4, characterized in that
- to the composition of the feed there are added automatically at least one or more auxiliary

substances, such as water, vitamins, medicaments, nutritive supplements, immunological stimulants, or growth stimulants, such as hormones.

6. A method as claimed in any one of the preceding claims, characterized in that

- an automatic determination of the composition of the milk or mother's milk is effected,
- on the basis of said determination, the milk or mother's milk yielded by the milking machine is automatically discharged or stored in a first or further storage means.

7. A method as claimed in any one of the preceding claims, characterized in that

- the milk or mother's milk yielded by the milking machine is cooled down and stored in a liquid or solid phase in a first or further storage means.

8. A method as claimed in any one of the preceding claims, characterized in that

- one or more characteristics, such as an identification number, of the dairy animal, such as a cow from which the milk or mother's milk has been yielded, are stored in a memory,
- the milk or mother's milk from the dairy animal is supplied to the corresponding individual animal, such as a calf or a cow.

9. A method as claimed in any one of the preceding claims, characterized in that

- the current nutritive requirements of the individual animal are determined with the aid of automatic means,
- the composition of the feed is attuned to the current nutritive requirements of the individual animal.

10. A method as claimed in any one of the preceding claims, characterized in that

- the automatic means are adapted to determine the current nutritive requirements of the individual animal in an optical and/or acoustic manner, and/or on the basis of the weight and/or one of more

dimensions of the individual animal.

11. A method as claimed in any one of the preceding claims, characterized in that

- the data relating to the determination of the current nutritive requirements, nutritive need, the composition of the milk or mother's milk and the composition of the feed are stored in a memory, and
- one or more characteristics, such as an identification number, of the individual animal are stored in a memory.

12. A method as claimed in any one of the preceding claims, characterized in that

- suitable milk or mother's milk stored in the first or further storage means is selected on the basis of the data stored in a memory.

13. An implement for applying a method as claimed in any one of the preceding claims, characterized in that the implement comprises a transport system for liquids, a metering device and a feeding station for animals which is coupled to a milking machine.

14. An implement as claimed in claim 13, characterized in that the transport system is adapted to supply the milk or mother's milk from the milking machine directly to a metering device, or that the transport system is adapted to supply the milk or mother's milk to a metering device after the milk or mother's milk has been stored in a first or further storage means.

15. An implement as claimed in claim 13 or 14, characterized in that the implement comprises automatic means for determining the current nutritive requirements and nutritive need of the individual animal, which automatic means are adapted to measure the condition and/or the growth and/or the weight and/or the blood pressure of the individual animal.

16. An implement as claimed in any one of claims 13 - 15, characterized in that the composition of the feed is attuned to the current nutritive requirements of the individual animal, which composition consists of milk and auxiliary substances or mother's milk and auxiliary substances and which composition corresponds to a previously ad-

justed composition of the feed, which previously adjusted composition is stored in a memory.

17. An implement as claimed in any one of claims 13 - 16, characterized in that an algorithm calculates the previously adjusted composition of the feed for the individual animal on the basis of data stored in a memory, which data comprise values relating to the condition, growth and weight of the individual animal.

18. An implement as claimed in any one of claims 13 - 17, characterized in that a memory stores the values relating to the determination or calculation of the current nutritive requirements, and/or the nutritive need, and/or the composition of the milk or mother's milk and/or the composition of the feed.

19. An implement as claimed in any one of claims 13 - 18, characterized in that the means adapted to measure the condition of the individual animal comprise a picture processing device and/or a colour sensor and/or an air sampling device and/or a sphygmomanometer and/or a temperature sensor.

20. An implement as claimed in any one of claims 13 - 19, characterized in that the means adapted to measure the growth of the individual animal comprise acoustic and/or optical sensors, or a picture processing device.

21. An implement as claimed in any one of claims 13 - 20, characterized in that the means adapted to measure the weight of the individual animal comprise a pair of scales, strain gauges or piezo elements.

22. An implement as claimed in any one of claims 13 - 21, characterized in that the metering device is provided with a feeding trough and/or a drinking spout, such as a flexible nipple.

23. An implement as claimed in any one of claims 13 - 22, characterized in that the metering device is provided with a temperature sensor.

24. An implement as claimed in any one of claims 13 - 23, characterized in that the implement is provided with an automatic mixing device adapted to add auxiliary substances to the milk or mother's milk, which auxiliary substances

are attuned to the current nutritive requirements of the individual animal.

25. An implement as claimed in claim 24, characterized in that the automatic mixing device is provided with storage means for storing auxiliary substances such as water, medicaments, vitamins, nutritive supplements, immunological stimulants, or growth stimulants, such as hormones.

26. An implement as claimed in any one of claims 13 - 25, characterized in that the transport system comprises computer controlled valves.

27. An implement as claimed in any one of claims 13 - 26, characterized in that the implement is provided with a first and a second volume flow meter.

28. An implement as claimed in claim 27, characterized in that the first volume flow meter is suitable for measuring the amount of milk or mother's milk.

29. An implement as claimed in claim 28, characterized in that the second volume flow meter is suitable for measuring the amount of feed supplied by the transport system to the metering device.

30. An implement as claimed in any one of claims 13 - 29, characterized in that the implement comprises an automatic analysis device adapted to perform measurements on the milk or mother's milk.

31. An implement as claimed in claim 30, characterized in that the automatic analysis device is adapted to measure whether the milk or mother's milk is suitable for being supplied to an animal.

32. An implement as claimed in any one of claims 30 - 31, characterized in that the automatic analysis device is adapted to measure the composition of the milk or mother's milk.

33. An implement as claimed in any one of claims 30 - 32, characterized in that the automatic analysis device is adapted to store in a memory the amount and/or the composition of the milk or mother's milk and one or more characteristics of the individual animal from which the milk or mother's milk has been yielded.

34. An implement as claimed in any one of claims

30 - 33, characterized in that the automatic analysis device is adapted to measure colour, cell count, hormones, germ count, nutritional value, contamination and concentration of antibiotics in the milk or mother's milk.

35. An implement as claimed in any one of claims 30 - 34, characterized in that the automatic analysis device is adapted to apply DNA-analysis techniques, such as PCR and NASBA, to the milk or mother's milk.

36. An implement as claimed in any one of claims 30 - 35, characterized in that the automatic analysis device is adapted to remove the milk or mother's milk from the implement or to supply same to a first or further storage means.

37. An implement as claimed in any one of claims 14 - 36, characterized in that the first storage means is provided with one or more reservoirs.

38. An implement as claimed in claim 37, characterized in that the first storage means is provided with coolers.

39. An implement as claimed in any one of claims 37 - 38, characterized in that the first storage means is provided with a temperature regulator.

40. An implement as claimed in any one of claims 37 - 39, characterized in that a memory is adapted to store the position of the milk or mother's milk in the first storage means, one or more characteristics, such as an identification number, of the individual animal from which the milk or mother's milk has been yielded, and the composition and/or the amount of the milk or mother's milk.

41. An implement as claimed in any one of claims 37 - 40, characterized in that the first storage means is adapted to store the milk or mother's milk in a liquid phase.

42. An implement as claimed in any one of claims 37 - 41, characterized in that one or more reservoirs are designed as refrigerated tanks.

43. An implement as claimed in any one of claims 37 - 42, characterized in that one or more reservoirs are designed as carousels and/or as sample racks.

44. An implement as claimed in any one of claims 14 - 36, characterized in that the further storage means is

provided with one or more reservoirs.

45. An implement as claimed in claim 44, characterized in that the further storage means is provided with coolers.

46. An implement as claimed in any one of claims 44 - 45, characterized in that the further storage means is provided with a temperature regulator.

47. An implement as claimed in any one of claims 44 - 46, characterized in that a memory is adapted to store the position of the milk or mother's milk in the further storage means, one or more characteristics of the dairy animal from which the milk or mother's milk has been yielded and the composition and/or the amount of the milk or mother's milk.

48. An implement as claimed in any one of claims 44 - 47, characterized in that the further storage means is adapted to store the milk or mother's milk in a solid phase.

49. An implement as claimed in any one of claims 44 - 48, characterized in that one or more reservoirs are designed as freezing chambers and/or freezing-dry chambers.

50. An implement as claimed in any one of claims 44 - 49, characterized in that one or more reservoirs are designed as carousels and/or as sample racks.

51. An implement as claimed in any one of claims 13 - 50, characterized in that the implement comprises one or more temperature regulating means adapted to warm up the feed automatically, so that the feed is adapted to be consumed by the individual animal.

52. An implement as claimed in any one of claims 13 - 51, characterized in that the implement comprises means adapted to sterilize and/or pasteurize the feed automatically.

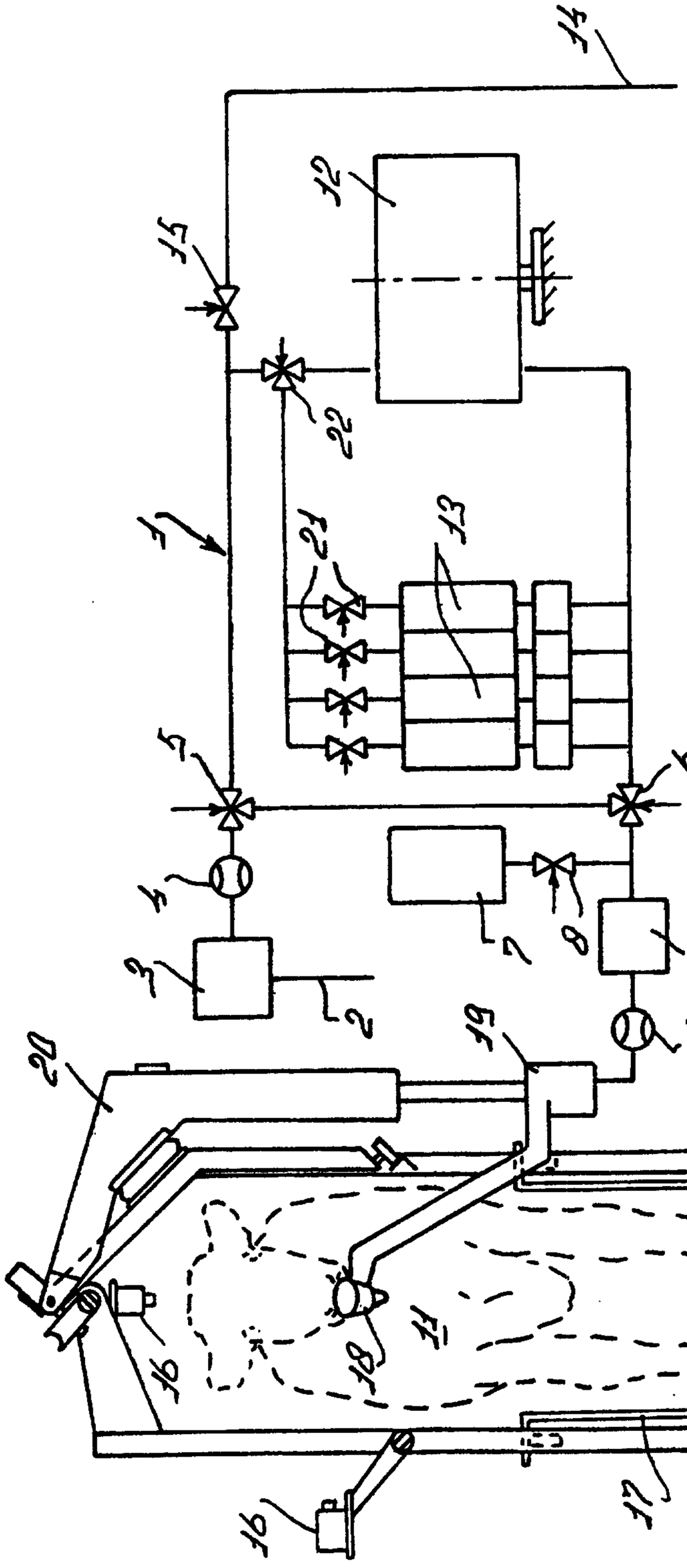
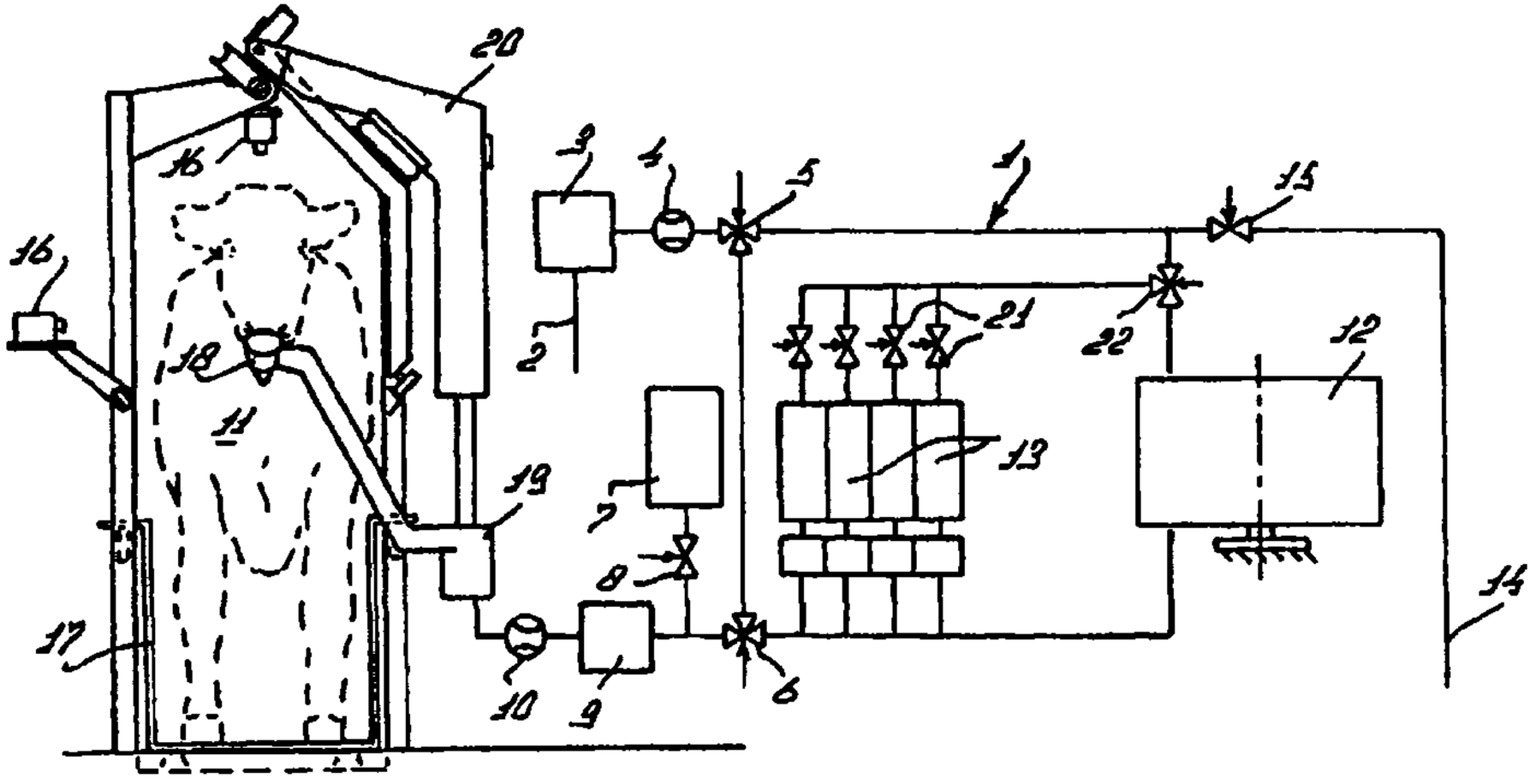


Fig. 1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