ASPECTS ON TESTING IN LABORATORY CONDITIONS OF AN ELECTROMAGNETIC PULSATOR

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Abstract

The efficient operation of the mechanical milking operation in the milking rooms, implies the use of pulsers, which allow to change the ratio between the extraction phase and the massage phase and even the working frequency, during operation. These requirements are fully met by the electromagnetic pulsators. The operating organs of these pulsators are actuated by means of electric coils controlled by an electrical circuit. In this way, through the electrical control, various values of the working frequency and different ratios between the extraction and massage time can be achieved. In practice, certain values for the working frequency and certain values for the extraction-massage ratio are accepted at national and European level.

Based on these considerations, the author presents in the present paper the results of laboratory tests performed with an electromagnetic type pulsator of his own conception. The tested pulsator allows the production of two different working ratios (extraction time / massage time), namely: 3: 1 and 1.1, at a frequency of 60 pulses / minute. The switching from one working mode to another is controlled by the milk flow coming out of the milk collector.

Following the tests performed for various values of the vacuum in the installation, it was observed that the working frequency of the electromagnetic pulsator to be tested remains constant. This parameter is within the normal operating limits of 50 ... 60 +/- 3 pulses / min.

Also, the ratios between the extraction time and the massage time are within the usual values.

Key words: milk equipment; pulsator

INTRODUCTION

Extraction of milk, in modern milking systems, is possible due to the construction of the teat cup. At its level there are two concentric chambers, separated by a rubber sleeve. In the central chamber, a permanent vacuum is created, and in the outer chamber, the vacuum alternates with the atmospheric pressure.

The milk flow from the teat cups increases as the vacuum increases. It is accepted as normal the range of values for vacuum, between 40–50 kPa.[3].

Value of vacuum of 32... 42 kPa allows milking quickly, gently and completely, wuth no stress for the animal [2].

The alternation between vacuum and atmospheric pressure, in the outer chamber, is possible due to the existence of a component of the milking device called a pulsator. From the pulsator level, the external chamber is supplied alternately with air, at atmospheric pressure or at a lower value (vacuum).

The frequency of alternating cycles between vacuum and atmospheric pressure at the nipple cup is in most milking systems around 60 cycles / minute [1], although the frequencies between 50 and 60 cycles / minute are considered normal. [3]

The good operation of the pulsator influences certain parameters of the milking operation, namely: the frequency of the pulsations and the ratio between the extraction time and the massage time (50/50 - 70/30).

For proper operation the pulsators must maintain their rigging over time (the operation is not influenced by the environmental conditions or the wear of the components).

The author, in the present paper presents the results of laboratory tests, carried out with an electromagnetic pulsator, with drawers, with of his own design, electronically controlled according to the milk flow during the milking. The tested pulsator allows the working with two reports of the work phases (extraction / massage), namely: from 1: 1 and from 3: 1.

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MATERIAL AND METHOD

The pulsator used for testing is of its own design and can serve a single milker cluster (Figure 1). The working organs of the pulsator are of drawer type (two drawers). Each drawer performs an alternative rectilinear motion and is operated by two electromagnets.

The advantages of the working organs, drawer type, as compared to other types of working organs used for pulsators are: constructive simplicity; easier adaptation some constructive changes.

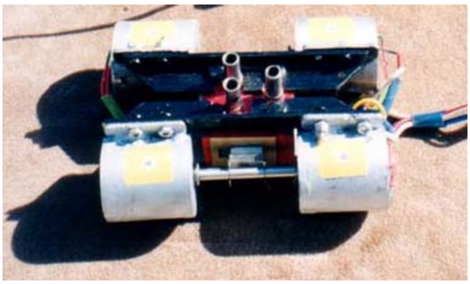

Fig. 1 The experimental electromagnetic pulsator

To determine the working parameters of the presented pulsator, was used a self-designed test rig (figure 2), provided with a milking system where the milk is collected in the milk bucket. Such a type of installation was chosen because it is simple and the component parts can be easily replaced.

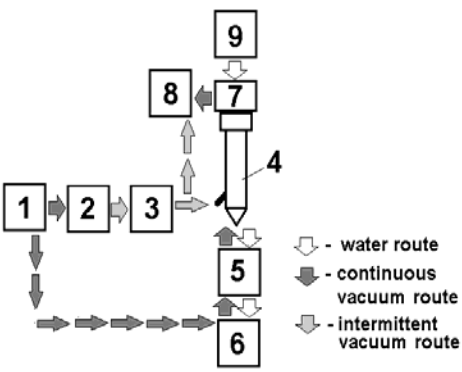

Fig. 2 Scheme of the test rig
1- equipment for vacuum production and adjustment; 2- pulsator; 3- vacuum distributor; 4- teat cup; 5- milking claw; 6- milk bucket; 7- support for supporting the teat cup; 8- recording equipment for working parameters; 9- water tank;

Teat cups with 25 mm inlet sleeve diameter were used for testing. The connection hose between the pulsator and the vacuum distributor is 2 m long.

To simulate the flow of milk through the teat cup during the operation of the stand, it was connected to a water tank and individually supported with a support. The water used during the tests was collected in the milk bucket.

We chose to use water instead of milk, as it has close physical properties.

During the tests, the variation of the pressure as a function of time, in the outer chamber of the teat cup, was recorded for different operating regimes. Thus the extraction and massage times, the duration of a pulse, as well as the working frequency of the pulsator were deduced.

The reference pressure was considered atmospheric pressure.

The values of the pressure recorded at the level of the outer chamber of the milking cup were correlated with the operating time of the pulsator.

Data recordings were made for two operating modes of the studied pulsator, namely: for the ratio of the working phases (extraction / massage) of 1: 1 and for the ratio of the working phases (extraction / massage) of 3: 1.

In order to raise the characteristic of the pulsator, it is necessary that outlet for the vacuum that transmits the pressure signal to the transducer is placed as close to the inlet connection in the outer chamber of the teat cup.

During the tests each connection for intermittent vacuum, of the studied pulsator, was connected to two teat cups. In this way the teat cups will work on the pairs, ensuring a more constant flow through the milking claw.

The test for pulsator was performed for two working modes:

- Regime 1 - ratio of the work phases (extraction / massage) was chosen by 1: 1;
- Regime 2 - ratio between the work phases (extraction / massage) was chosen by 3: 1.

Stand measurements were made for five values of the vacuum in the permanent vacuum pipe of the milking plant. These values were -48 kPa; -46kPa; -44kPa; -42 kPa; -40kPa.

RESULTS AND DISCUSSION

The data obtained from measurements made on the stand, for the two operating modes of the studied pulsator and for the five values of the vacuum for testing, were entered in ten tables.

Due to lack of space, only two of them are presented (table 1 and table 2), one for each operating mode of the studied electromagnetic pulsator, for the vacuum value in the continuous vacuum pipe, of - 46 kPa.

For an easy interpretation of the results, the values of the averages in the ten tables mentioned above are summarized in Table 3.

Table 1 The working parameters of the experimental electromagnetic pulser for operating mode 1, for the permanent vacuum value of - 46 kPa

No.	The duration of an working cycle [s]	Working frequency [cycles/min]	Ratio of the working phases (extraction time / massage time)
1	0.9932	60.410	1.000
2	0.9932	60.410	1.000
3	0.9932	60.410	1.000
4	0.9932	60.410	1.000
5	0.9932	60.410	1.000
6	0.9975	60.150	1.035
7	0.9975	60.150	1.035
8	0.9975	60.150	0.965
9	0.9975	60.150	1.035
10	0.9975	60.150	1.035
11	0.9975	60.150	0.965
12	0.9975	60.150	0.965
13	0.9975	60.150	1.035
14	0.9975	60.150	1.035
15	0.9975	60.150	0.965
16	0.9964	60.217	1.038
17	0.9964	60.217	0.962
18	0.9964	60.217	0.962
19	0.9964	60.217	1.038
20	0.9964	60.217	1.038
21	0.9964	60.217	1.038
22	0.9964	60.217	1.038
23	0.9964	60.217	0.962
24	0.9964	60.217	1.038
25	0.9964	60.217	0.962
arithmetic mean		**60.229**	**1.006**

Table 2 The working parameters of the experimental electromagnetic pulser for operating mode 2, for the permanent vacuum value of - 46 kPa

No.	The duration of an working cycle [s]	Working frequency [cycles/min]	Ratio of the working phases (extraction time / massage time)
1	0.9955	60.271	2.437
2	0.9955	60.271	2.437
3	0.9955	60.271	2.437
4	0.9955	60.271	2.235
5	0.9955	60.271	2.437
6	0.9918	60.496	2.052
7	0.9918	60.496	2.052
8	0.9918	60.496	2.052
9	0.9918	60.496	2.052
10	0.9918	60.496	2.052
11	0.9964	60.216	2.785
12	0.9964	60.216	2.785
13	0.9964	60.216	2.785
14	0.9964	60.216	2.785
15	0.9964	60.216	2.785
16	0.9964	60.216	2.312
17	0.9964	60.216	2.312
18	0.9964	60.216	2.312
19	0.9964	60.216	2.312
20	0.9964	60.216	2.312
21	0.9936	60.386	2.176
22	0.9936	60.386	2.375
23	0.9936	60.386	2.176
24	0.9936	60.386	2.375
25	0.9936	60.386	2.375
arithmetic mean		**60.317**	**2.368**

Table 3 The values of the working frequency media and the working phase ratio, of the experimental electromagnetic pulsator

No.	Working pressure [kPa]	Working frequency for operating mode 1 [cycles/min]	Working frequency for operating mode 2 [cycles/min]	Ratio of the working phases for operating mode 1	Ratio of the working phases for operating mode 2
1	-48	60.258	60.286	0.988	2.539
2	-46	60.229	60.231	1.006	2.368
3	-44	60.266	60.280	0.994	2.634
4	-32	60.259	60.315	0.981	2.266
5	-40	60.263	60.280	0.994	2.177
arithmetic mean		**60,247**	**60.278**	**0.992**	**2.396**

At the level of the depression connection, which is connected to the interior of the central chamber of the teat cup, the pressure remained around - 40 kPa.

As shown in Table 1, the frequency of the electromagnetic pulsator, for the working mode 1 (the ratio of the phases of 1: 1), is maintained around the average value of 60.23 cycles/min.. The difference between the maximum and the minimum value of the working frequency is 0.26 cycles/min, which allows us to consider that it remains constant under test conditions.

Regarding the ratio of the working phases (extraction time / massage time), for the working regime 1, it is found that the difference between the maximum and the minimum value is 0.07. So in this case it can be considered that the ratio of the work phases is constant.

According to table 2, for the operating mode 2, at the same value of the vacuum in the installation (-46kPa), it is found that the frequency of the electromagnetic pulser is maintained around the average value of 60.32 cycles/min.

The difference between the maximum and the minimum value of the working frequency is 0.28 cycles/min., which allows in this case to consider that it is kept constant.

Regarding the ratio of the working phases, for the working regime 2, it is found that the difference between the maximum and the minimum value is 0.38. So in this case it can be considered that the ratio of the work phases is constant.

The behavior of the pulsator is not influenced by the vacuum value in the system. As can be seen from table 3, the difference between the maximum and the minimum value of the frequency averages for the two operating modes is 0.08 cycles/min.

This is due to the fact that the active element (the drawer) is driven by the electrical coils that receive the signal from an electronic control circuit. The drag force of the drawer is not significantly influenced by the resisting force due to the variation of the depression in the drawer area, but more by the frictional forces between the moving elements.

Regarding the ratio of the working phases of the electromagnetic pulsator tested, it is found that the difference between the maximum and the minimum value for working mode 1 is 0.025, and for mode 2 of 0.45.

CONCLUSIONS

Following the tests performed, it is found that the pulsator retains its working frequency. The Deviations recorded for both working regimes, are not exceeding 0.3 cycles/min..

Since the frequency value is electronically controlled, working regimes with different desired working frequency values can be obtained.

Regarding the ratio of the work phases (extraction time / massage time), it is found that for regime 1 the differences are insignificant. For the working mode 2 it is observed that there are certain differences, which is due on the one hand to the fact that the test pulsator is a prototype and on the other hand, to the control signal received from the electronic part. This signal can be adjusted by a constructive improvement of the control circuit.

The electric actuation of the two drawers, allows to obtain different desired values for the working phases ratio of the electromagnetic pulsator tested.

Analyzing the above, it can be considered that the electromagnetic pulsator tested corresponds to the purpose for which it was made.

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