

<sup>1\*</sup>Department of Electrical Engineering, Power Engineering, Electronics and Automation, University of Warmia and Mazury in Olsztyn, Poland

<sup>2</sup> Eng. Student, Faculty of Technical Sciences, University of Warmia and Mazury in Olsztyn, Poland

\* Corresponding author e-mail: seweryn.lipinski@uwm.edu.pl

# AUTOMATED WATERING PLATFORM FOR THE USE IN GREENHOUSES AND PLANT NURSERIES

## ZAUTOMATYZOWANA PLATFORMA DO PODLEWANIA DO UŻYTKU W SZKLARNIACH I SZKÓŁKACH ROŚLINNYCH

**Summary:** The article deals with the automation of the watering process in cultivation of plants in greenhouses, tunnels, and plant nurseries. This paper introduces the patents and products related to watering systems as well as their characteristics and applications. Then, a new platform for automatic crop watering is presented, the design of which has been submitted for protection in the Polish patent office, under the number P.427964. Described construction is destined, *inter alia*, for the purpose of complementing the system that allows automatic control and monitoring of mushroom cultivation process.

**Keywords:** mushroom cultivation, patent description, process automation, watering platform

**Streszczenie:** Artykuł dotyczy automatyzacji procesu nawadniania w uprawie roślin w szklarniach, tunelach i szkółkach roślin. W artykule przedstawiono patenty i produkty związane z systemami nawadniającymi, ich charakterystykę i zastosowanie. Następnie zaprezentowano nową platformę do automatycznego nawadniania upraw, której projekt został zgłoszony do ochrony w polskim urzędzie patentowym pod numerem P.427964. Opisana konstrukcja przeznaczona jest m.in. jako uzupełnienie systemu umożliwiającego automatyczne sterowanie i monitorowanie procesu uprawy pieczarek.

**Słowa kluczowe:** uprawa pieczarek, opis patentu, automatyzacja procesu, platforma do podlewania

### Introduction

In the recent years, the development of widely understood agricultural engineering is virtually inseparable from the cultivation process automation [1]. Automation of various processes included in a production chain allows them to become more efficient and less engaging for the human operator [9]. The cultivation of plants being grown in greenhouses or in plant nurseries is no exception in this regard [8].

That is why the paper presents the automated watering platform destined for such use. The design of the described project is currently under protection by the Polish Patent Office, under the number 238890 [3]. The described construction is destined *inter alia* for the purpose of complementing the system that controls and monitors mushroom cultivation process in an automated manner [4].

### Recent patents on watering devices

Patent literature contains a description of many interesting watering solutions. The most interesting of them are described below.

One of the exemplary watering devices is an adjustable plant watering apparatus described in [14], in which inside the tank and the water dispenser there is a container rotatably mounted so that it can be emptied when filled. The unit provided with a floating piston, located inside the chamber, allows regulating the flow rate of water into the container by changing the level of water in the chamber, while the outlet opening in the chamber carries water to the container.

Other solution for watering (and feeding) system for plants is described in [5]. It comprises a container enclosing a platformed water reservoir, housing a water supply unit, a fertilizer dispensing unit, a nutrient conveying wick and a water level indicator unit, all of which are interacting to provide automatic and adequately measured amounts of nutrients to the plants, embedded in soil on top of the platformed water reservoir.

A customizable potted plant watering apparatus described in [13] is made up of a variety of interconnecting parts to form one or more separate elongate trays which are arranged in any fashion but generally one above the next. Each tray section is adapted for supporting one or more potted plants. The trays are interconnected by flexible tubes so that when water is introduced into an upper tray it flows downwardly into subsequent lower trays.

When the trays are attached at both ends to end sections, they form a finished shelf into which water may be introduced to hydrate and feed the plants by root absorption. The end sections are held in place by a snap on cover which also engages a screen to provide an effective watering tray and a clog free system.

Another invention is a tool for watering of flowers [2], consisting of a bar with a fork hanger at the end, in which a rocker is hinged on the pins, to which a handle is attached in the form of a tubular fitting, equipped with two side projections in the middle part, and on the shorter end with an internal thread cooperating with the thread on the container in bottle form. One arm of the rocker arm is connected with the rod by means of an elastic element, while the other, opposite arm is connected by a rod with a one-sided lever mounted on the rod. An extension cap is attached to the longer end of the handle.

Next interesting system is described in [12]. It is a mobile, enclosed plant growing apparatus including a plumbing/irrigation system. The plumbing/irrigation system includes a modularized reservoir system, light tight piping, growing buckets, risers, and sprinklers. A liquid nutrient solution is pumped from the reservoir system, through the piping, into the buckets through the risers, exiting from the sprinklers.

A plant watering system including a tray having a platform thereon in which a water absorbent mat is located is described in [10]. The mat extends into the tray in which water is located and water is absorbed from the tray into the mat by capillary action. The plants are located on the mat and are provided with water directly to the plant bottom and water is available to provide humidity to the leaves. A stackable arrangement is provided so that one tray can be stacked on top of another one.

The last exemplary solution is apparatus for drip-watering of pot plants known from [11]. It is characterized in that it has a container which is a plastic bottle turned upside down with a filler opening at the bottom, and a drainage tube is placed in the cap, connected to a distribution manifold, the ends of which are provided with the filters that are placed over the pots, the tank being attached with clamps to a vertical hanger and resting on its bottom part corresponding to the shape of the neck of the tank.

All the above discussed designs are characterized by their motionless, while one of the main features of the proposed watering platform is its mobility.

## Design of the automated watering platform

Figure 1 shows a general view of the entire automated watering platform, being the main subject of the article. Figure 2 shows the arrangement of elements on the platform, and Figure 3 shows a bottom view of the platform.

The base for the device consists of a support frame (1), serving as a watering platform carrier and wheels (2) that should be properly selected, i.e., considering the type of ground. The platform is driven by stepper motors (3) controlling the chain transmission system (4), which allows the support frame to move forward and backward. The stepper motor (5) and gears (6) are responsible for the torsion of the support frame. The

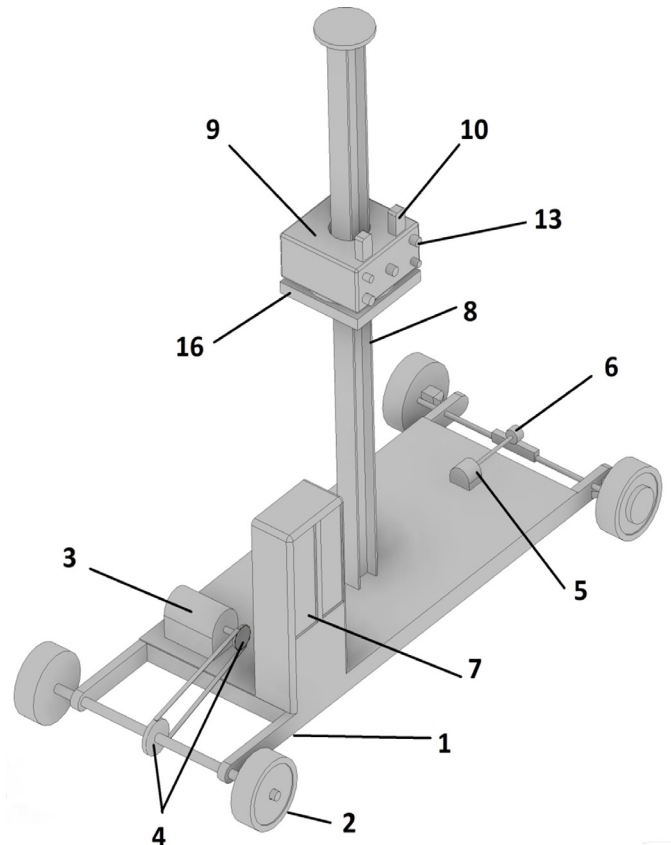


Fig. 1. Automated watering platform – general view

entire system is controlled by an actuator installed in the control cabinet (7). In the centre of the frame there is a guide (8) on which a movable watering platform (9) with sprinklers (10) is installed. Platform (9) is also equipped with the sensors (13) responsible for a proper movement (finding the track).

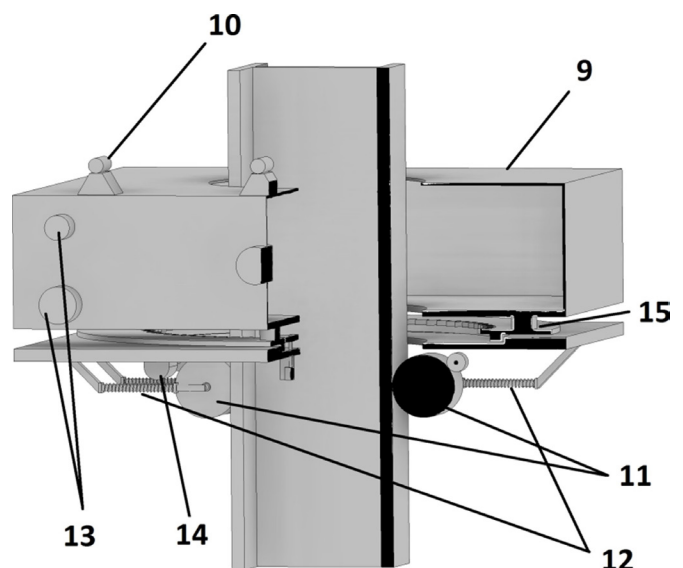


Fig. 2. Cross-section and arrangement of elements on the watering part

Figure 2 shows the main executive element of the watering platform, i.e., the rotatable watering part that consists of pressure wheels (11) with a spring (12), which are parts responsible for stabilizing the watering element consisting of sprinklers (10) and previously mentioned sensor system (13). The motor (14) is responsible for moving the platform (9) up and down.

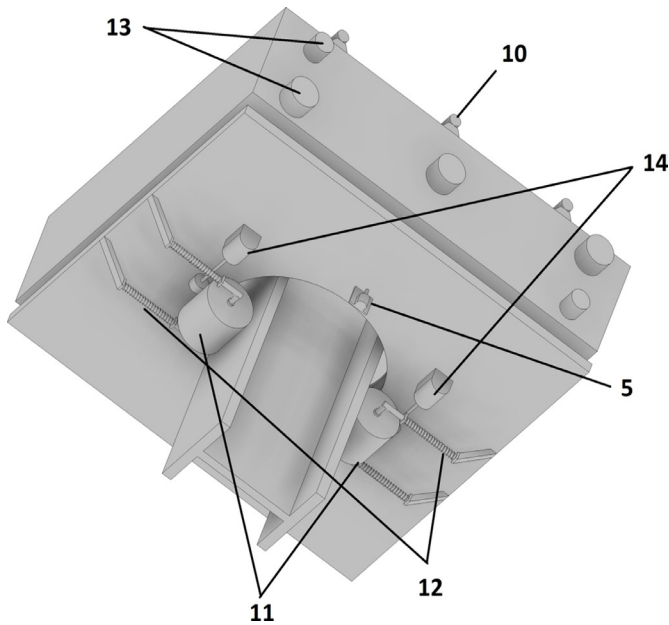


Fig. 3. Bottom view of the watering platform

Figure 3 shows again the motor (14) responsible for raising and lowering the watering part, and a motor (5) being used for rotating the rotatable watering part.

The principle of operation of the presented watering device is as follows. The platform, after programming its operation and installing sprinklers that are appropriate for a given crop, is placed in the workplace, and then started. It drives to the cultivation site in a programmed manner with the use of motors and a drive (Fig. 1, elements 2, 3, 4, 5 and 6). Based on the analysis data from the sensors (13), it finds the crop and starts watering while moving forward. The platform allows the watering of multi-level crops, in which case, after completing the watering of one level, the height of the platform is changed accordingly (by means of the motor (14)).

Depending on the used software, it is possible to irrigate both single-level crops (e.g., tomatoes, cucumbers) and several-level crops (e.g., mushrooms).

## Summary and conclusions

Automation of processes included in the sequence of activities that make up the cultivation of various types of agricultural products, plays an increasingly important role in widely understood agriculture.

One of the processes that could be automated is watering, which is a labour-intensive and repetitive activity. That is why we proposed the new device, i.e., automated watering platform.

The key advantages of the presented construction are speed and precision of watering, what translates into savings resulting from both the optimization of plant irrigation and reduction of labour costs. Another advantage of the presented construction is its mobility, distinguishing it from the known solutions in the field of automatic crop irrigation, some of which are described in section 2 of this paper.

The innovative nature of the described watering platform is confirmed by its application to the patent office and in consequence, its protection [3].

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Article reviewed

Received: 25.03.2024/Accepted: 10.04.2024