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IMPLEMENTATION AND DESIGN SMARTCONTROL ON THE PRODUCTION OF DRIPPERS IN THE PIPES OF THE IRRIGATION SYSTEMS

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ABSTRACT

This article aims to manufacture and produce drippers in irrigation pipes used in agricultural lands. These drippers have standard specifications and are cylindrical. The control system is designed to control the type of drippers and measure the distance between drippers. It also determines the rate of discharge, pressure, temperature, and humidity through existing sensors in the control system. The control system works on the move of the perforation cart along the irrigation pipe. Using these drippers increases the efficiency and enhancement performance of the drip irrigation system through many factors such as type, distance, pressure, temperature, and humidity. The study showed that the productivity of drippers through the use of control system increases the number of drippers and improves the quality of drippers within the pipes of the drip irrigation system. Additionally, they prevent runoff and deep sedimentation of water, which causes waste of water. On the one hand, this study showed that controlling the rate of discharge leads to saving the water prepared for irrigation. The results indicated good agreement between theoretical result and experiment control system.

Keywords: control panel, drippers, production, pipes, perforation, irrigation systems.

1. INTRODUCTION

Plastic applications that are widely used in many fields of engineering may cause environmental problems, because the raw material of plastic materials is petroleum. In agricultural lands, which are the most important natural resources, misuse of these types of materials or production of these materials from inappropriate materials would result in irreversible environmental damage. In this context, undesirable results of these types of materials began to be observed in drip irrigation applications. Principal results are break-up of drip irrigation pipes during usage due to mechanical, biologic, or solar effects and clogging of the pipes in the system due to low quality of irrigation water. The pipes, which broke up or became useless due to clogged drippers, remain in agricultural land or are collected and discarded in another place. A drip irrigation system includes pump unit, control unit, main pipeline, manifold pipelines, lateral pipelines and drippers [1]. Flat drip irrigation pipes, which are analyzed in the present study, are termed as lateral pipelines [2]. Drippers are placed inside the pipe at certain distances during the production, and dripper pipes fit into the pipe according to the production method, and the pipes are then ready for use. These drippers can be round or flat drippers [3]. The flat drip irrigation pipes are produced by adding a drip cap inside the pipe at certain distance during pulling of pipe from the mold through extrusion from low density polyethylene (LDPE). Wall thicknesses of the pipes vary between 0.12 mm and 0.60 mm. When polyethylene (PE), which is produced from synthetic polymers from petroleum, is discarded to the nature, it causes environmental pollution and toxic material accumulation, as it cannot be degraded in the soil for a long time. When they are destroyed by burning, they cause emission of toxic materials into the air. In addition, since they are used in agricultural lands, the damage they give becomes more significant [4]. Polyethylene is manufactured by two main methods which are high and low pressure processes. Low density polyethylene (LDPE) and copolymers are produced by high pressure process, while high density polyethylene and newly developed linear LDPE type are produced by low pressure process [5], [6]. The drip irrigation pipe production system is a perforation unit. The perforation process is accurate and requires all stages of operation in the production line. This process is controlled by highly efficient programmable and electronic control to get different measurements as needed. The principle of operation of the drip irrigation pipes production system is through extrusion of plastic materials in a single screw extruder. Plastic materials are pulled and formed through a specially designed die head to produce the pipes while allowing for the pre-designed dripper insertion process at the same time. Drippers are distributed along the pipe at distances to be determined according to demand. The initial cooling of the pipe is followed by the final cooling of the pipe, which is in several basins. The cooling of the produced pipe does not entirely finish. The pipe carrying the drips inside passes through the perforation unit, where several holes are made on the pipe walls above each drip at the drain outlet of the drip. The process of pulling and tightening the pipe from the extruder through the parts of the line is from the calibration, cooling, and perforation, and it is done by the haul off unit. This device works to tighten the pipe with constant force to overcome the friction resistance in various stages. All operation stages of the production line are controlled by electrical and electronic systems. These systems are characterized by high precision and programmed control system to ensure uniform performance [7-10].

The aims of this article are to program and control production numbering and quality drippers with time to increase efficiency and improvement performances for irrigation systems. These includes any parameters such as dripper line selection, wall thickness, dripper discharge, the spacing between drippers, spacing between dripper lines, specification of dripper line insertion depth (in SDI) (subsurface drip irrigation).

2. DESIGN OF HARDWARE SYSTEM

The purpose of designed hardware structure is to show the information of the system which contains pressure, temperature, dripper discharge, and humidity, as well as the control of the production of the round drip irrigation pipes. In equivalent circuit, the signals are processed and then transferred to the interface unit to process and then entered into the computer to take control of the application of this controller designed with the requirements of a system and to consequently offer a message to the operator for the user to create the right selection. The Equivalent circuit consists of circuits of all parameters of manufacture and production of the round drip irrigation pipes. The photograph of equivalent circuit and the block diagram are shown in Figures 1, 2.

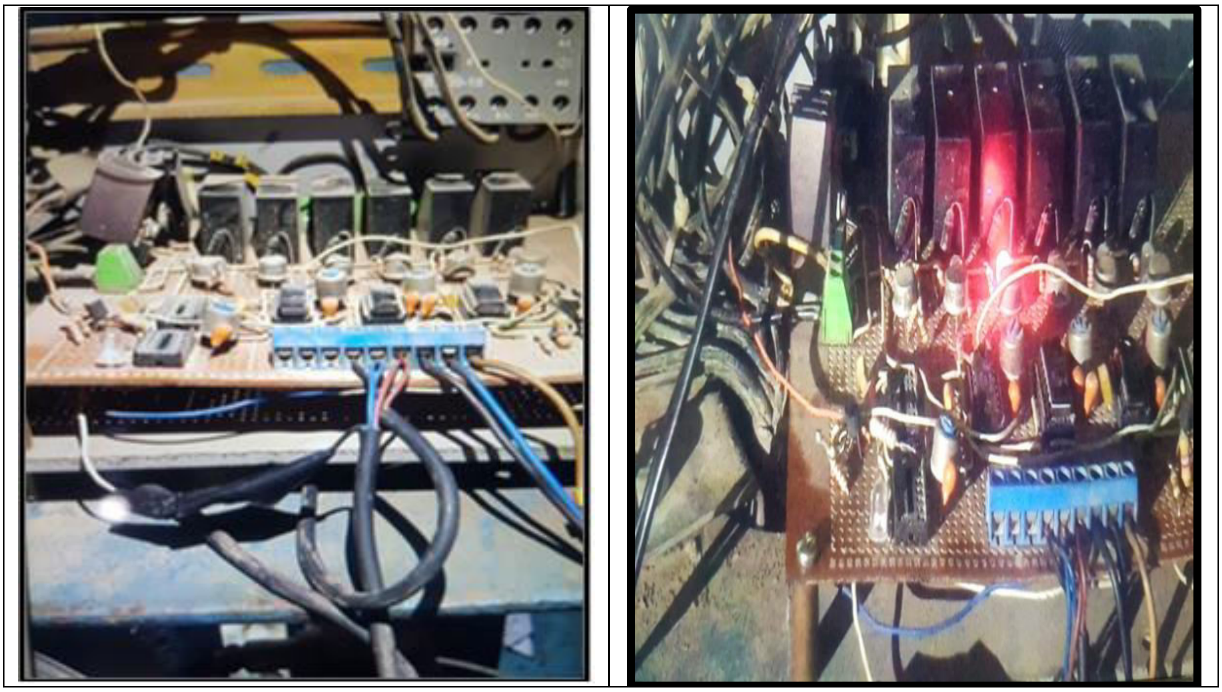

Figure-1. Electric and electronic system for control before and after operation.

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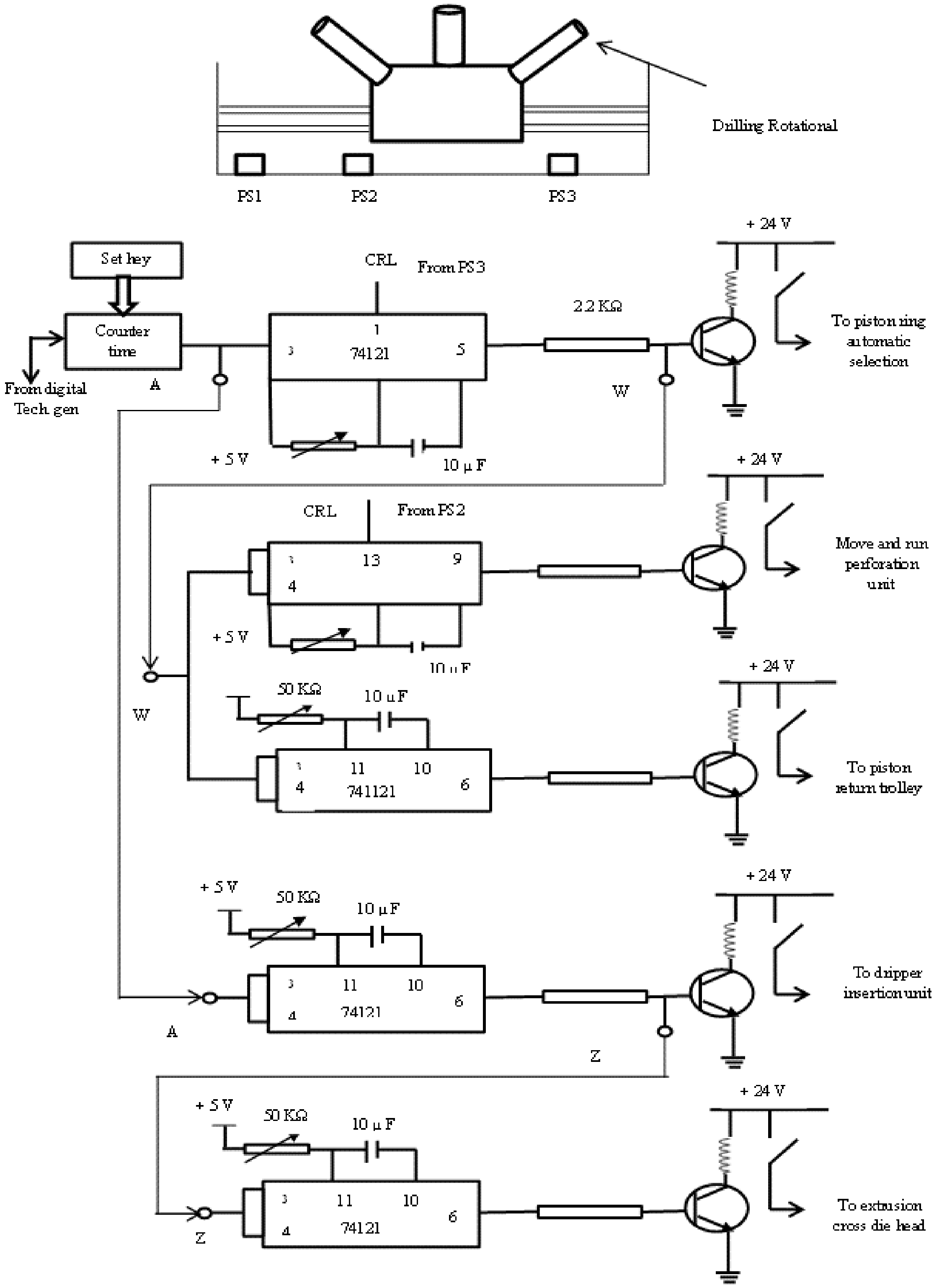

Figure-2. Schematic diagram of the equivalent circuit of the produced drippers.

3. OPERATION OF THE SYSTEM

The electronic circuit manages the dripper pipes production process and keeps distance from both the drippers. This distance is constant without any change in length by preserving the stability of the specified perforation sites of the dripper. It measures the length dripper pipe with a digital tachometer generation that creates pulses which represent the length of the dripper pipe. Then, they are inserted into a counter timer containing a fixed key that produces the necessary duration of durability by the output and the distance between the drippers shown in Figure-3.

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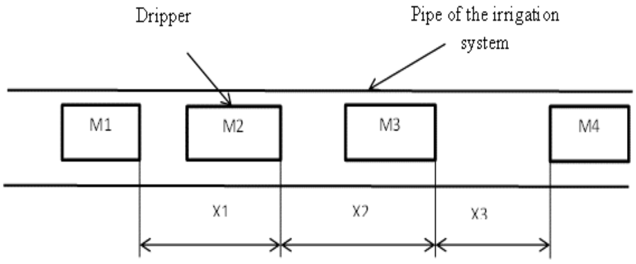

Figure-3. The distance between the drippers pipe.

X1=X2=X3------Xn=constant (1)

The distance entered by the set key to the counter timer is a reference value which compares the number of pulses showing the length of the pipe with drippers that come from a generation of electronic tachometers, in order to decide to start the punching head's job. This is indicated through the punching head's motion while operating the PS1. The PS1 gives the start signal drilling and gives a stop signal drilling when the punch head arrives at the sensor (PS2). The preset holder frees the tray when the punch head arrives at the sensor (PS3) and returns the head to the first position. A new dripper is expected to be inserted and the pattern repeats.

4. THE PERFORATION UNIT IN THE PRODUCTION APPARATUS OF THE DRIPPER PIPES

The drilling device consists mainly of three air motor drills with a locating ring operated by an air piston. This unit reads and locates the dripper when it passes through the perforators unit and by the mechanical system. It also works with high accuracy to avoid any operational errors that can arise from the error of locating the dotted and drilling. To ensure high operational speed, pneumatic pistons are used to move the parts of this unit. The work of the drilling unit begins when the drip (inside the pipe) reaches the ring, causing a complete movement of the drilling system on the guide bars. The electrical signals start consecutively from the computer control system and give orders to the various parts of the unit. The completion of the drilling process and the return of the drilling cart to the starting position lead to preparation for the next drilling run. The pneumatic braking of the moving system must be at the specified location with the required accuracy to the shock absorber generated by the sudden stop of movement. The operation process starts between the beginning and end of the unit. Perforation strokes depending on the computer program working for this purpose. This process will rely on a distinct system to read the location of the dotted and the cart during the stroke of the perforation (position control). This case will lead to avoid errors that result in the case of relying on the time proportion of movements. Figure-4 depicts perforation unit and Figure-5 schematic diagram of the perforation unit. The drippers developed as shown in Figure-6 are based on the control system used in the experimental study

Figure-4. The perforation unit used to production the drippers.

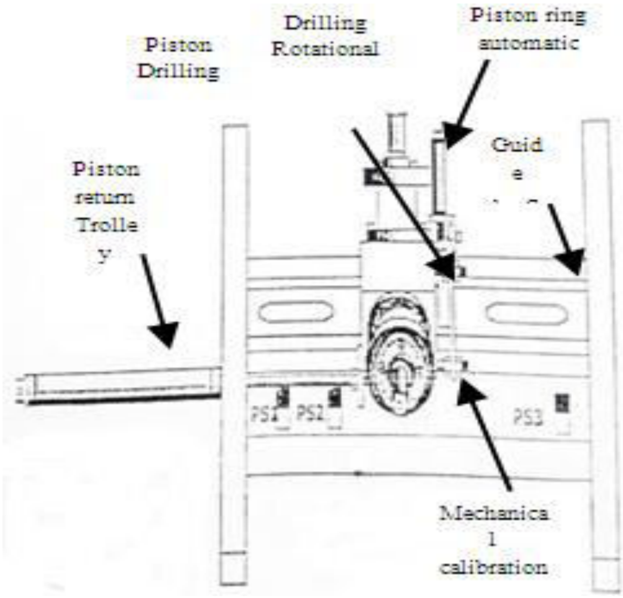

Figure-5. Schematic diagram of the perforation.

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Figure-6. The produced drippers according to the control system used in the experimental study.

Table-1. Specification of the produced drippers according to the control panel used in the experimental study.

Dripper outer diameter	**18 mm**	**Pipe internal diameter**	**13.5mm**
Dripper internal diameter	12mm	Wall thicknesses of the pipes	1.1 mm
Dripper spacing	400 mm	Line head pressure	1 bar
Dripper length	73mm	Initial total line flow	510 LPH
Weight of the pipe	55gm/m	Discharge of the pipe	LPH

5. TEST DRIPPERS AND VALIDATION

The product is tested by sampling a random or predetermined sample at a time interval. The external specifications of the selected specimens of the pipe, such as diameters and thickness, are checked. The pump is operated first to calibrate the pressure required for testing (by the pump controller unity). The test time is determined by the electronic timer on the control panel (the test period is 36 seconds) after which a standard cylinder is inserted under the drain hole to the dripper. After that, the pump is turned on and collects the water from the dripper discharge into the standard cylinder. The amount of accumulated water is recorded after the pump is stopped and to determine the operating conditions, the water temperature reading is recorded. The previous steps are repeated at different pressures. For the purpose of work reliability, the drawing is made between the discharge of the dripper and the pressure of the flow of water in the drip tube Figure-7. The diagram shows the inside of the tube which contains water Drippers produced by the control system of the current studying.

6. DRIPPERS INSERTION UNIT

This unit inserts the cylindrical dripper into the tube during the pull process through the pull head region at the required speed, while ensuring high accuracy in adjusting the required distances between the drippers inside the pipe. This system operates with pneumatic pressure to ensure the speed of input as this system is controlled by logic programming. Pneumatic pressure is processed in terms of cleaning - moisture withdrawal - lubrication. The required operating pressure is between 5-6 bars and the input capacity is 100 dripper/ min.

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Figure-7. A. The produced pipe according to the control system during and after the perforation used in the experimental Study, B. The produced pipes and used in the irrigation systems.

7. RESULTS AND DISCUSSIONS

During this study, the process of producing cylindrical water drippers and design specifications precisely through the use of electrical and electronic control system. The control system deals with many important factors in the productivity of these water drippers. These parameters are perforation of the drippers, the number of these drippers, the distance between the dripper and another, the temperature of cooling water in the basins and pressure and humidity. The experimental study deals with all the important factors in the design of water drips which affects the performance of irrigation pipes in agricultural lands. These factors include the rate of discharge through the drip where this factor was considered in order to prevent runoff as well as deep infiltration, which may cause wastage of water intended for drip irrigation. The water drippers were tested through a dripper's inspection system which focuses on the rate of discharge through the water drippers. The relationship between pressure and discharge rate is an important criterion in the production process of water drippers and so is the extent to which they achieve the quality and performance of the drippers. The study showed other types of drippers obtained according to other measurements and what is determined by the product as shown in the Figures 8, 9, 10.

Figures 11, 12, 13 indicates the important characteristics of water drippers such as pressure, flow rate, and length, and these figures show the range of conformity between theoretical and experimental for these characteristics.

Figure-14 represents the punching head and operating start signal where the pipe perforation process is performed within the dripper at the specified locations. Figure-15 is the signal of the end of the punching process as well as the perforation work. Figure-16 represents the perforation process end signal. This signal means that the perforation head is returned to the first sensor (PS1) site. Simultaneously, the signal coming out of the sensor (PS3) is the signal of the return of the perforation head and defines the speed of return where that frequency is proportional to the rate at which the pipe passes at the head of the perforation, by means of the proportional valve command. Simultaneously, the outgoing signal (PS3) goes to the control circuit shown in Figure-15 giving the punching head release order as shown in Figure-17 Describing the tube release signal. The system works by regulating the proportional valve to overcome the shortcomings of the produced systems.

The return speed of the punching head is relative to the passing speed of the tube in the perforation system, (production rate). The suggestion of a perforation mechanism is not a reasonable error to determine the location of the perforator in the perforation system.

Figure-8. The first type of water drippers different size.

Figure-9. The Second type of water drippers.

Figure-10. The third type of water drippers.

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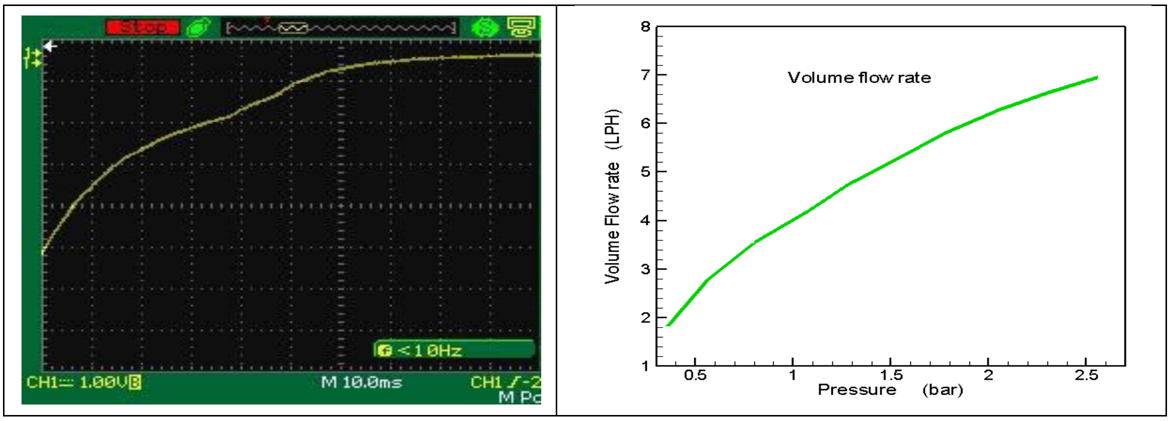

Figure-11. Experimental and theoretical curve for Q & P.

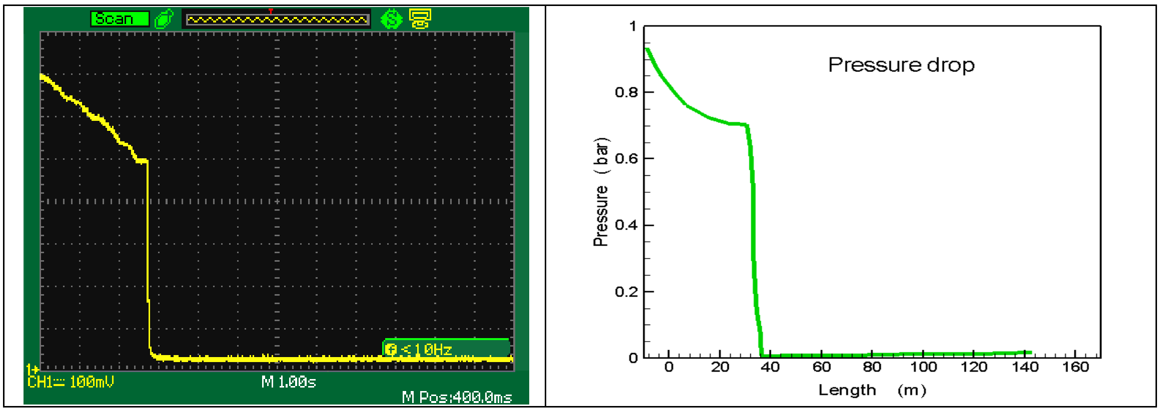

Figure-12. Experimental and theoretical curve for P & L.

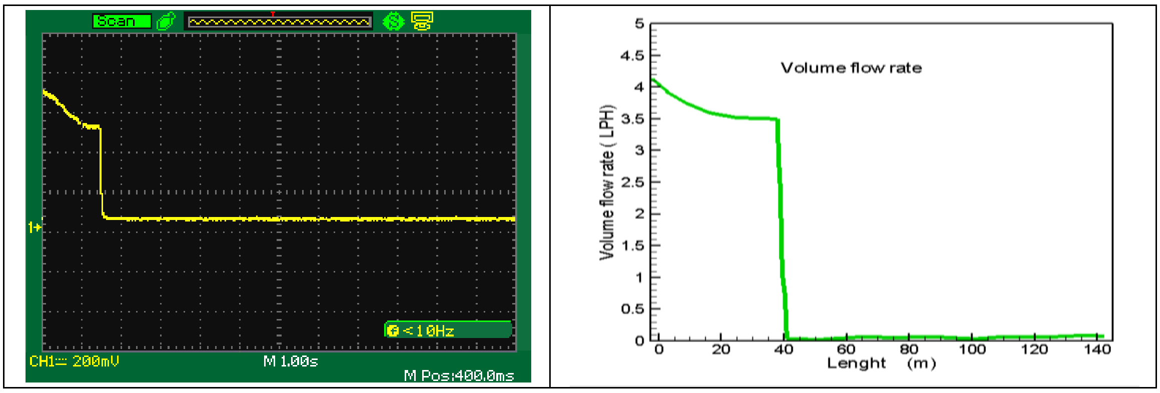

Figure-13. Experimental and theoretical curve for Q & L.

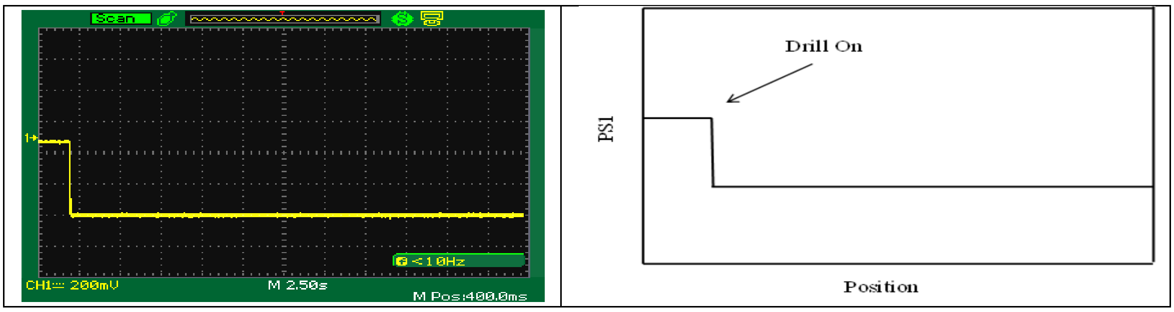

Figure-14. Experimental and theoretical the punching head and operating start signal.

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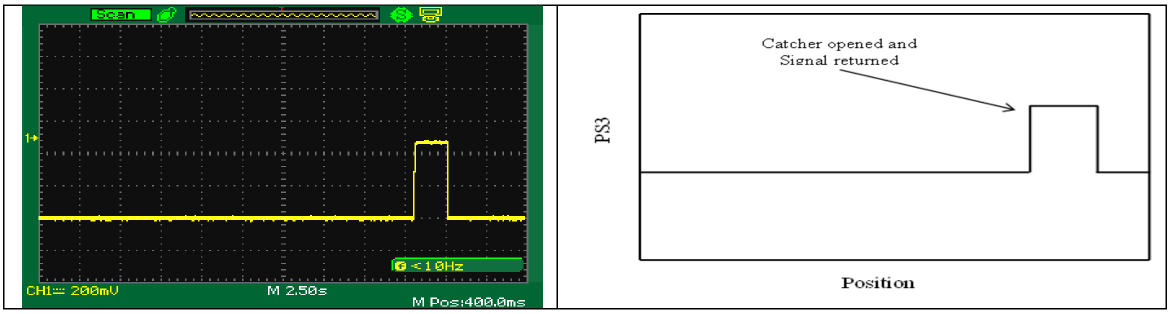

Figure-15. Experimental and theoretical curve the signal of the start of the punching process.

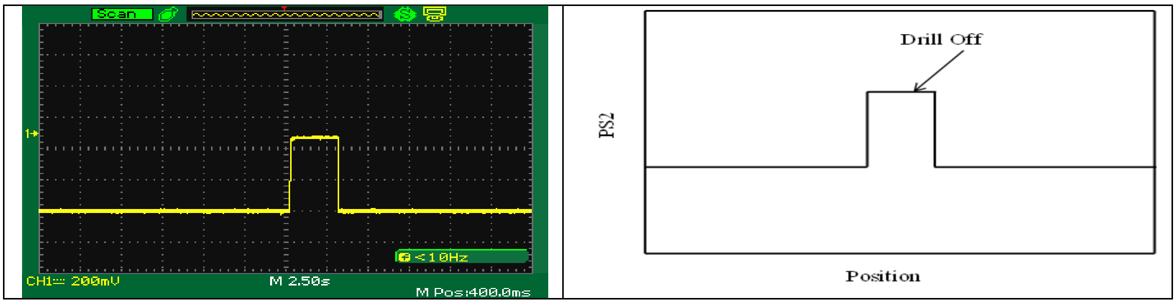

Figure-16. Experimental and theoretical curve of the perforation process end signal.

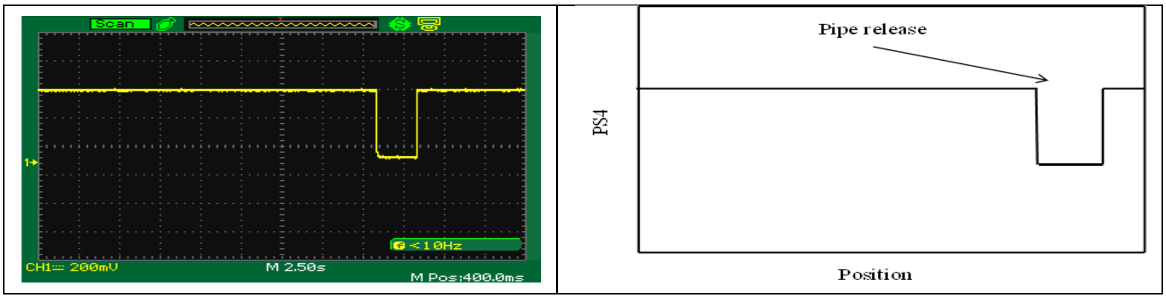

Figure-17. Experimental and theoretical curve the tube release signal.

8. CONCLUSIONS

a) The system works by regulating the proportional valve to overcome the shortcomings of the produced systems. The return speed of the punching head relative to the passing speed of the tube in the perforation system (production rate), as well as the suggestion of a perforation mechanism is not a reasonable error to determine the location of the perforator in the perforation system.

b) Uniformity and efficiency.

c) Uniformity saves water and fertilizer and improves yield, resulting in a shorter ROI (return on investment).

d) Efficiency saves resources and preserves the environment while optimally serving the crop's needs.

e) While using the control system of the drippers, perforations can be obtained to improve water drippers.

f) Control on the rate of discharge for water using water drippers saves water.

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