

Design of an automatic production line for oil barrel renovation

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Abstract: Aimed at solving the shortcomings of oil barrels artificial renovation, low efficiency, low security, cleaning not clean, and such problems as environmental pollution. Touch screen and PLC are used as control system, an automatic renovated production line is designed. it is made up of the burner, sandblasting machine, shaping machine, polishing machine, feeding barrel device, loading and unloading oil barrels device. Experiments show that the cleaning method is combined with burning and sand blasting, and shaping and polishing process, the automatic renovation of oil barrels is implemented, production efficiency is improved and environmental pollution is also reduced.

1. Introduction

At present, 200L steel barrels are mainly used to hold various chemical products such as fuel oil and lubricating oil[1]. After the use of oil barrels, its inner walls and outer walls produce dirt and rust, and it can only be reused by cleaning[2]. The cleaning methods of oil barrel include chain cleaning, soak cleaning and high-pressure water jet cleaning[3]. The basic cleaning methods are, the chain cleaning which puts a long chain into barrel, through a variety of rotating barrels, the inner wall of the chain and barrel generate friction through friction force to remove the barrel rust and oil removal by adding alkali, this cleaning method can remove a lot of rust and oil, but there are serious shortcomings, such as high noise, high labor intensity, low efficiency and complex process, and destruction of the oxide layer on the surface of the barrel, the barrel accelerated corrosion, shorten the service life of oil barrel[4]. Method of soak cleaning is to spray cleaning liquid into the barrel and dissolve the dirt and drain out of the barrel[5]. High-pressure water jet cleaning is through using the force of high pressure water jet, so that the dirt and rust in the barrel fall off the inner wall of the barrel, and its disadvantage is that there is a cleaning dead angle, and the cleaning is not thorough enough[6]. At present, equipment of oil enterprises which engaged in oil barrel renovated industry are not advanced, efficiency of production is extremely low, and they mainly rely on artificial operation, causing serious pollution to the local environment[7].

The production line designed in this paper adopts the combination of burning and sandblasting cleaning method, and uses the new process of shaping and polishing to renovate waste oil barrels, and according to the actual needs of production, it develops the production process and process requirements, finally designs an automatic production line of oil barrel renovated.

2. System process and composition

System process flow are, working process of the barrel renovated production line is that cleaning the dirt on inner wall of the barrel, correcting the shape of the oil barrel and polishing the barrel. First of all, it clarify the characteristics of the dirt, after analysis, the dirt mainly are formed by oil

and rust, by burning oil barrel wall to get rid of the oil, and the remaining oil and rust are removed by blasting to clean. The oil barrel will deform for some time, the waste oil barrel can rectify the deformation of the barrel by shaping. An oil barrel that is polished to obtain a bright, smooth surface. The process flow is shown in Fig.1.

An oil barrel renovation automatic production line designed in this paper is a renovation for 200L oil barrels, which can be renovated to the production equipment required by 200L oil barrels. The mechanical system of this production line adopts modular design, which is mainly composed of Loading barrel, burning, sand blasting, shaping and polishing modules. Fig.2 is a block diagram of this mechanical system, and Fig.3 is the mechanical system. The residue on the inner wall of the oil barrel is burned by the burner through the loading barrel of the loading barrel mechanism, so as to facilitate the cleaning of the sand blasting machine. After burning, the oil barrel can be rotated an angle, and the sandblast machine is used to spray the sand cleaning. Sand blasting has two functions, one is the sandblast cleaning, removing the surface oxidized skin, the rust turbidity, achieve the decontamination effect, the second is sandblast reinforcement, which is used to strengthen the surface and improve fatigue life by using the high speed motion. After the sandblast machine cleaned the oil barrel, the shaping machine is used to correct the roundness of the oil barrel.

Shaping machine is through the barrel outer shaping roller and the inner support roller barrel for swelling pressure to adjust waste oil barrel body is concave and convex parts, which make whole body to achieve the required roundness. Its working principle is that the shaping roller press barrel outer wall, supporting the roller support oil barrel wall, rotating at the same time, relying on friction drive oil barrel rotation, through the interaction of both the roller to achieve the purpose of the shaping. The oil barrel after the shaping is sent to the polisher. The main purpose of polishing is to wash and polish the heavy adhesion dirt inside the oil barrel to obtain a bright and flat surface. The whole production line set up waste treatment, preventing environmental pollution caused by burning which produce harmful gases, harmful gas through the waste management was recycled into the pool, in the form of waste water disposal, protecting the environment.



Fig.1 Process flow

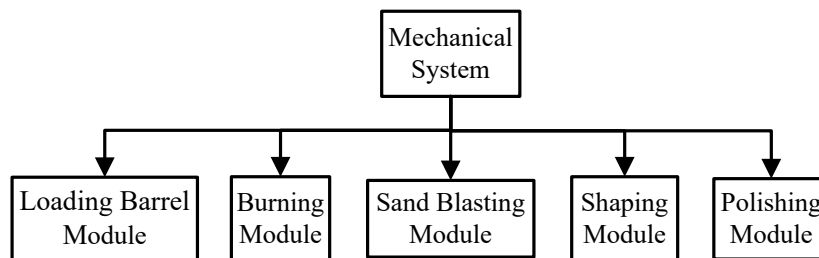


Fig.2 Diagram of component

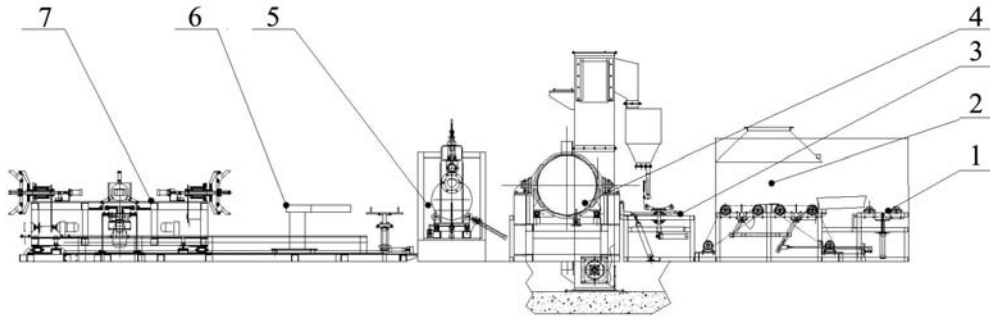


Fig.3 Diagram of mechanical system

1. Loading barrel mechanism 2. Burner 3. Rotating barrel device 4. Sand blasting machine 5. Shaper
6. Barrel feeding device 7. Polishing machine

3. Control system design

The control system consists of electric control part, pneumatic control part and hydraulic control part, which integrates machine, electricity, gas and liquid. Electrical components consist of PLC, contactor, relays, inverters, and photoelectric sensors. Pneumatic control part consists of cylinder, air pump, the electromagnetic directional valve, such as pneumatic components. Hydraulic control part consists of oil pump, oil cylinder, solenoid directional valve and oil tank of hydraulic components. In human-computer interaction, fault diagnosis and so on easy to intuitive understanding of the production process and monitor the dynamic change of signal, by the upper computer cooperate with PLC, the production line designed the control system of touch screen and PLC. Control system structure diagram is shown in Fig.4 as follows. According to the requirements of the production line by the number of I/O points and system control, PLC uses Siemens S7-200 type, touch screen with Siemens 6AV6545-0DB10-0AX0 model.

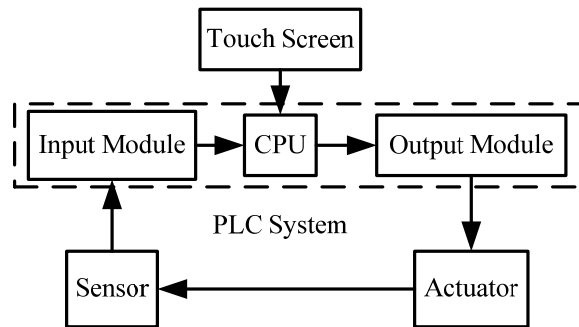


Fig.4 Diagram of control system structure

4. Experimental analysis

Experiments are carried out on the automatic production line of oil barrel. The experiment shows that the dirt in the inner wall of the oil barrel is clean, the shape is complete, and good finish. Production lines can be renovated with multiple barrels of oil at the same time, and each barrel from loading barrel to unloading barrel takes just two minutes, it effectively increases productivity. The results of artificial and automatic renovation are shown in Table 1.

Table 1. Results of artificial and automatic production lines.

Renovating Method Property	Artificial Renovation	Automation Renovation
Cleaning effect	Poor	Good
Effect of shaping	Nothing	Exist
Surface smoothness	Rough	Smooth
Work environment	Bad	Fine
Time-consuming	About 30 minutes	About 2 minutes
Production efficiency	Low	High
Security	Low	High

5. Conclusions

The present situation, process and production requirements of the automatic production line of oil barrel are analyzed in the paper, and the whole scheme and composition of the automatic production line of waste oil barrel are determined. This production line own the advantages of strong practicability, high automatic degree, high stability, good reliability, easy to control and reducing manual labor intensity, improving production efficiency, easy to maintain and improvement, etc. At the same time, some defects in the current production line of waste oil barrel are solved, but the production line of the barrel is still to be improved, such as loading barrel mechanism can change the artificial loading barrel to the automatic loading barrel, the intelligence of this production line are the main content for future research.

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References

- [1] Xu B, Zhu X Q. Research and design of oil barrel cleaning process [J]. Science Mosaic, 2012, (7) : 161-162.
- [2] Yuan Y. China's recoverable steel barrel market is broad [N]. China Packaging Newspaper,2004-10-13 (3).
- [3] Yang W L. Market analysis of international industrial packaging and recycling [N]. China Packaging Newspaper, 2007-3-9 (3).
- [4] Chang D L. Oil barrel hydraulic cleaning device [J]. Journal of Chongqing Institute of Technology, 2002, 16 (6) : 20-22.
- [5] Zhu L P. The standardization of steel barrel packing containers in China [J]. Packaging Engineering,2010, 35 (9) : 136-139.
- [6] Tu M L. The development of the 200 liter barrel cleaning device [J]. Mechanical & Electrical Engineering Technology, 2004,33 (2) : 32-33.
- [7] Wang D Z. Metal packaging container [M]. Beijing: Chemical Industry Press, 2003.