Establishment of Profile Production Line for Shipbuilding in Shipyard

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ABSTRACT

Shipbuilding is production industry that integrates processing and assembling of parts. Establishment of specialize production line is effective way to improve quantity, efficiency, quality of processing part. Profile Production Line is first put forward in shipbuilding in this paper, which based on CNC profile cutting machine and CNC frame bending machine. The paper introduces the main components and its functions in detail and gives an example in Chinese shipyard.

The profile cutting machine performs cutting functions mainly, for example opening in the web of profile, end cut-off. It can also fulfill the marking and nesting functions before bending. CNC frame bending machine mainly performs the bending of profile automatically, such as Frame Bending Robot developed by us. It is the first CNC frame bender in the world and has been used successfully in some Chinese shipyard. The main features will be discussed in the paper in detail. It contains feeding mechanism, vertical pre-bending mechanism, pneumatic marking mechanism, auto-detecting device and CNC control model. The profile processing data flow will be shown from shipbuilding software system to processing used by CNC device. The data interface between shipbuilding software system (such as Tribon) and CNC frame bender is very important for digital manufacturing, and has been settled down successfully.

Though the proposed profile production line, the profile processing in shipbuilding could be finished automatically with the whole digital, more accurate and higher efficiency. That will be a renovation in shipbuilding. It will be benefit to the shipbuilding and shipyard.

KEY WORDS: profile; production line; shipbuilding; CNC frame bender; cutting; bending; shipyard.

INTRODUCTION

Modern Shipbuilding Production Mode points out that shipbuilding is integration and complex process to use group technology, computer technology, Hull/Outfitting/Painting integration technology. During it, the principles of Group Technology and Flexible Manufacturing System are that putting the similar part in shape or function integrated processing to improve productivity. So it is very effective production method to establish a production line for some interim product.

Henry Ford, an American, invented Assembly Line, which is a modern industrial mode for mass production based on the Taylor’s management idea on efficiency-oriented. To build a simple, reliable and affordable car that the average American worker could afford is his dream. By means of this high production mode, in eighteen years, more than 15,000,000 Model T cars came from assembly plants all over the United States. Model T car is unique in automobile history both in quantity and in last time. Due to specialization and standardization of processing part, the establishment of the assembly line increases the efficiency of manufacture and decreases its cost. The assembly line reversed the process of automobile manufacture. It makes the car common in the American and in the world.

Shipbuilding is clearly different from automobiles. One does not see a ship coming off the assembly line every minute with relatively standard. Due to the single or small lot manufacture for ship, the development of assembly line based on mass production is slow at shipyard. But, with the introduction and establishment of Modern Shipbuilding Production Mode, people generally know that the modern manufacturing should include assembly line or production line. Hence, at the last time 20 century, all kinds of production line (also called assembly line) are erected at shipyard for shipbuilding, for example steel plate pre-treatment line, NC plasma cutting machine line, panel block assembly line, production line for curved block, pipe fabrication line, profile cutting line, etc. It is no doubt that these specialized productions are contributed to high quality, less time waste and high productivity.

However, there is no specific production line (assembly line) to establish at civil or aboard shipyards to deal with the processing of profile and hull plate. This is the cause that the processing and forming is very difficult. At meantime, there is no practical forming control theory although many research works have been done. The end point measuring method is one.

Taking profile (frame) processing as an example, profile cold bending belongs to elastic and plastic deformation. First, there is an elastic springback after bending. There is no good method to predict the springback. Second, due to the asymmetrical section of profile, there is warping deformation, which is vertical to the direction of bending. In order to prevent it, some anti-deformation methods are taken, such as backup plate with different thickness. This make the bending model more complex. Besides, there are also some other bad effects on the profile happen during the bending process, such as buckle and collapsing side. All will have an influence on the establishment of profile production line if there is no good profile bending machine.

At present, most domestic and foreign shipyards adopted the manual method to operate the frame bender. By the aid of temple or reverse straight line, the shape of profile is controlled. CNC frame bending machine is seldom used. This is the reason that there is no real profile production line at the shipyard.