Proceedings of the 2022 International Conference on Smart Manufacturing and Material Processing (SMMP2022), A. Nayyar (Ed.)

doi:10.3233/ATDE220825

The Study on the Structure Design of the Dynamometer Lifting Platform

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Abstract. The lifting support platform is a part of the vehicle thermal balance test bed. Its main function is used to carry out the thermal balance test of the vehicle, effectively and reliably connect the dynamometer to the rear end of the vehicle gearbox through the cardan shaft, and effectively and reliably ensure the successful completion of the vehicle thermal balance test. In this paper, the use of UG software to draw the dynamometer parts diagram, and then assembly, finally the assembly drawing is obtained. To put it into production, the physical map is completely obtained.

Keywords. Dynamometer, Lifting platform structure, UG, Angular plate, Lateral guide bush

1. Introduction

With the rapid development of urbanization, lifting platform as a kind of aerial work equipment and automobile manufacturing industry has become the basic equipment of the industry. Increasing attention has been paid to lifting platforms, which are widely used in various fields such as landscape architecture, transportation, airport and municipal administration [1-3]. Lifting platform can not only expand the scope of operation, improve work efficiency, reduce labor intensity, more importantly, increase the safety of staff.

Dynamometer lifting platform consists of 5 layers of functional board, 4 moving column composed of the movable lifting part and fixed electric push rod base, 4 fixed column, a base plate composed of the basic part and three parts of the electric push rod. In this paper, the UG software is used to draw the parts diagram of dynamometer, and then assembly is carried out to obtain the assembly diagram. Finally, the physical diagram is completed in production to ensure the feasibility and correctness of the structure [4-6]. The structure diagram of dynamometer lifting platform is shown in Figure 1.

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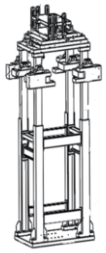

Fig. 1. Structure diagram of lifting platform

2. The Structure Design of Each Part of Dynamometer

Figure 2 shows the schematic diagram of the actual size of the swing angle plate. According to the actual size on the diagram, open the UG software to draw the swing angle plate. The specific steps are as follows: First, draw the bottom plate with the length size is 1160, the width size is 88 mm, and the drawing thickness is 50. Then build a sketch at the top and bottom, draw the required holes and slots, constrain the size, mirror and stretch to complete the drawing of the parts, as is shown in Figure 3 is the three-dimensional drawing of the swing angle plate.

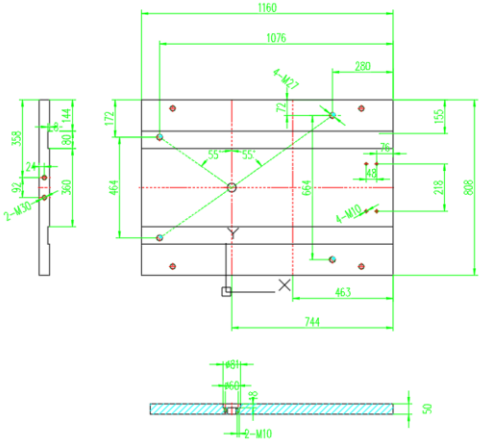

Fig. 2. Dimension diagram of swing angle plate.

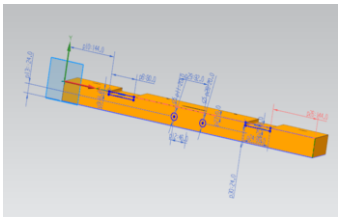

Fig. 3. Three-dimensional diagram of swing angle plate.

Figure 4 shows the size diagram of the fixed block for swing angle adjustment. According to the size diagram, the three-dimensional diagram of the fixed block for swing angle adjustment as is shown in Figure 5 is drawn. The detailed procedure is as follows: Create a sketch, draw a rectangle of 80*80 and a circle with a diameter of 20, constrain their positions, and stretch. Draw two circles with a diameter of 12, constrain the size and position, stretch, and complete the drawing of the swing angle adjustment fixed block parts.

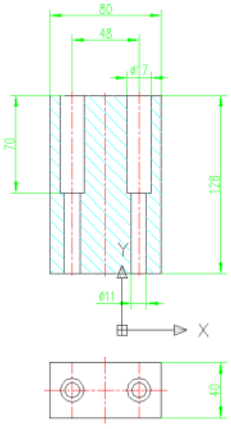

Fig. 4. Size diagram of fixed

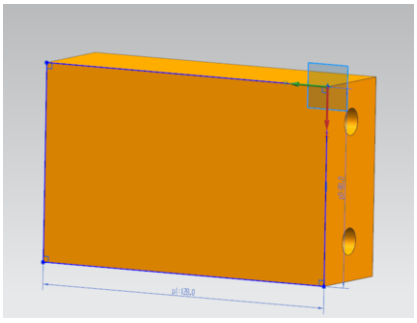

Fig. 5. Three-dimensional diagram of fixed block swing angle adjustment for block for swing angle adjustment

Figure 6 shows the size diagram of the fixed block for swing angle adjustment. According to the size of the figure, the three-dimensional diagram of the fixed block for swing angle adjustment as is shown in Figure 7 is drawn. The detailed procedure is as follows: Create a sketch, to drawing a rectangle that the size is 80*80 and a circle with a diameter of 20, constrain their positions, and stretch. Draw two circles with a diameter of 12, constrain the size and position, stretch, and complete the drawing of the swing angle adjustment fixed block parts.

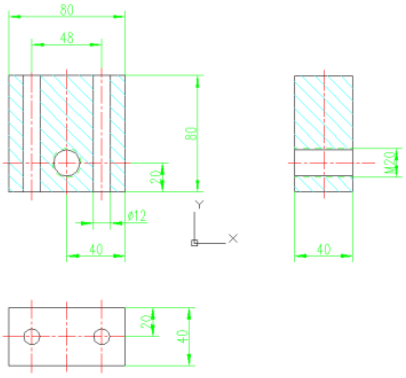

Fig. 6. Size diagram of fixed.

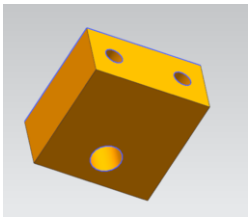

Fig. 7. Three-dimensional diagram of block for swing Angle adjustment block for swing angle adjustment.

Figure 8 is the size diagram of the swing push rod. According to the size of the figure, draw the three-dimensional diagram of the swing push rod as is shown in fig.9.

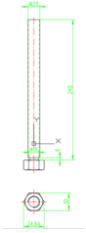

Fig. 8. Dimensions of the swing push rod

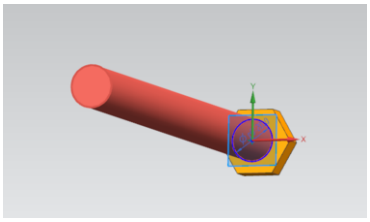

Fig. 9. Three dimensional diagram of swing push rod

As is shown in Fig. 10, it is the size schematic diagram of the swing axis. The three-dimensional diagram of the swing angle axis is drawn according to the actual size. The specific operation steps are as follows: to establishing a sketch and to drawing circles with diameters of 80, 40 and 24. Finish the sketch and stretch the size of 17, 97 and 144, respectively. Draw a sketch on the surface of a circle with a diameter of 80, draw concentric circles with a diameter of 11 mm and 17 mm, constrain them to the correct position, subtract by Boolean operation, and stretch the size of 20 and 11, respectively. Build a sketch on a circle with a diameter of 24, draw a circle with a diameter of 20, complete the sketch, subtract by Boolean operation, and stretch the size from 42 to 50, as is shown in Figure 11.

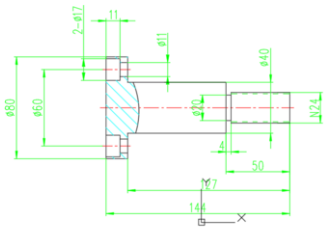

Fig. 10. The schematic diagram of the dimensions.

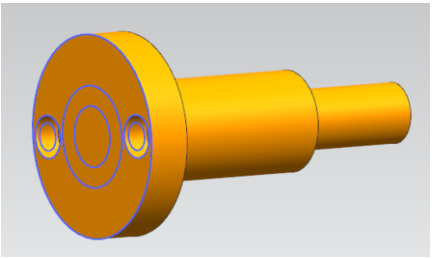

Fig. 11. The pendulum shaft of the pendulum shaft.

As is shown in Fig. 12, it is the size diagram of the lateral guide sleeve. It is drawing a three-dimensional diagram through the known size. The specific operation steps are as follows: to establishing a sketch, drawing concentric circles with diameters of 70 and 24, and stretch the size of 26 and 144, respectively. Draw a size of 16 diameter circle in the center based on the previous step, subtract by Boolean and stretch the size of 144. Build a sketch on the surface of a circle with a diameter of 70,to drawing concentric circles with a diameter of 17 and 11, mirror the concentric circles, subtract by Boolean operation, and stretch the size of 20 and 11 respectively, as is shown in Fig. 13.

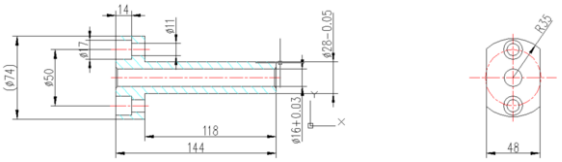

Fig. 12. Dimension diagram of the side guide sleeve.

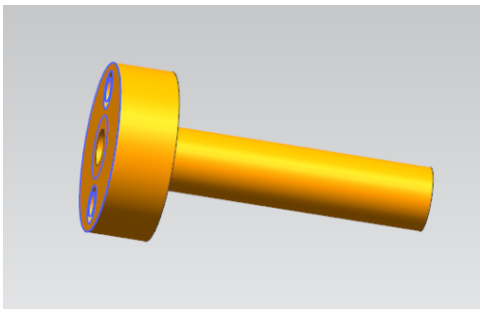

Fig. 13. Diagram of side guide sleeve.

Figure 14 shows the size diagram of the second floor. According to the actual size of the diagram, to drawing the three-dimensional diagram of the second floor as is shown in Figure 15. The detailed procedure is as follows: create a sketch in the XY plane, to drawing a rectangle with the size of 710*808, complete the sketch, and stretch the size of 50. A sketch was made on a plane of 710*50, and three threaded holes with a diameter of 24 and a depth of 36 were drawn, with a distance of 48, 124 and 220, respectively. Sketch on the plane of 710*50, draw two rectangles of 12*26, the distance between the two rectangles is 334, the distance from the edge is 80, subtract

by Boolean operation, and stretch the size of 808. Sketch the plane of 710*808, draw the keyway which size is 164*27, the depth is 50, then draw the circle with the diameter of 24, array this circle, the distance is 55, the center of the circle to the side is 94.5 away from the rectangular edge, stretch after finishing the sketch, subtract by Boolean operation, stretch the size of 50, Build a sketch in the X and Y directions of the center of the rectangle which size is 710*808 respectively, mirror the keyway and the through-hole, and dig a key way of 40*100 on the plane of 710*808, and constrain its position.

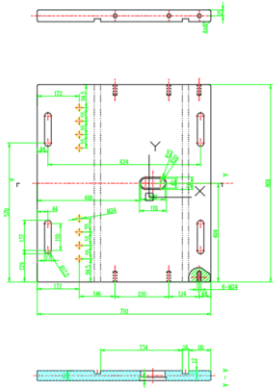

Fig. 14. Dimension diagram of the second floor.

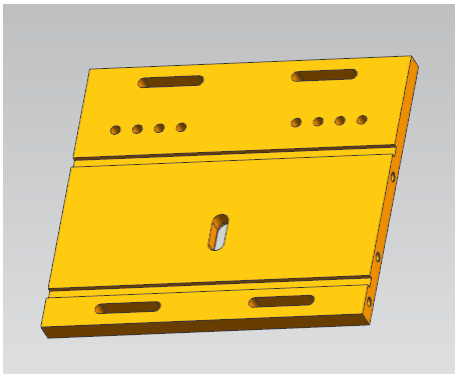

Fig. 15. 3D diagram of the second floor.

The size diagram of the third floor is shown in fig. 16. According to the actual size, the three-dimensional diagram of the third floor is drawn in the three-dimensional software. The specific operation steps are as follows: to establishing a sketch in the XY plane, draw a rectangle witch size is 1060*808, complete the sketch, and stretch the size of 50. Then build a sketch on the plane of 1060*808, draw a rectangle of 240*100, and constrain its position. The distance from both sides is 284 and 40 respectively. Draw keyways that the length is130 and the width is 27, constrain their positions, 364 and 30 away from the edge, then draw through-holes 24 in diameter, constrain their positions to 184 and 219, finally establish a reference plane in XZ and YZ planes, mirror keyways and through-holes, select all keyways and through-holes, subtract by Boolean operation, Stretch for 50. To create a sketch on the surface of an XY rectangle, draw a rectangle with sides 400 long and 250 wide, and fillet the corners with a straight angle radius of 20. Select the figure, subtract by Boolean operation, and stretch by 50. Build a sketch in the XZ plane, draw a rectangle which size is 76 × 50 , select the rectangle, subtract by Boolean operation, stretch by 50 , and mirror the feature. A circle with a diameter of 32 was drawn in the center of the rectangle, subtracted by Boolean operation, stretched by 708 , and two holes were punched 25 outside the center with a depth of 16 and a diameter of 10 , and the feature was mirrored. Draw two rectangles that the longth is 26 and the height is 5 in the XZ plane, 226 away from the edge, and 334 away from the two rectangles. Select the two rectangles, subtract by Boolean operation, and stretch the size of 808. Draw two rectangles 80 in length and 5 in height, 144 away from the edge, and 440 away from the two rectangles. Draw a circle 20 in diameter in the center of the YZ plane. Select the two rectangles and the circle, subtract by Boolean operation, and stretch the size of 1060, as is shown in Fig.17.

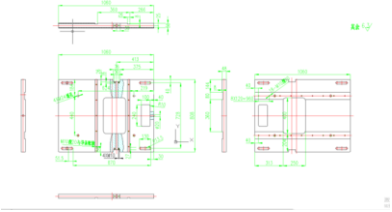

Fig. 16. Dimension diagram of the third floor

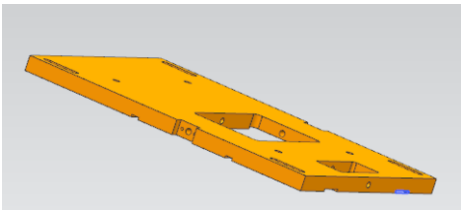

Fig. 17. 3D view of the third floor

Fig.18 shows the two-dimensional diagram of the moving block of the locking mechanism. Based on the diagram, we can know all the dimensions, and use the software to draw the three-dimensional diagram. The specific operation steps are as follows: A sketch was established on the XY plane to draw the contour of the locking mechanism moving block, a line 295 long was drawn along the positive direction of the X axis, and concentric circles with diameters of 120 and 60 were drawn at the center of the circle 60 up, and a tangent line with a length of 170 was drawn along the negative direction of the X axis from the circle with a diameter of 120. Draw a circle with a diameter of 60 at the center of the circle 30 up, and draw a tangent line with a length of 210 along the positive direction of the Y-axis from the left. Draw a circle with a diameter of 60 at the center of the circle 30 to the right, and to drawing a tangent line with a length of 93 along the positive direction of the X-axis from the top. Then draw a line that the size is 70 in the positive direction of the Y axis, a line which size is 218 in the negative direction of the X axis, and a line that the size is 460 in the negative direction of the Y axis. Use the trimming tool to build the excess circle, and then decant all the right angles with a length of 10. Finish the sketch, and stretch the size of 82. Select the smaller circle of the concentric circles, subtract by Boolean, and stretch by 82. Build the sketch in the YZ plane, draw a concentric circle with diameters of 35 and 50 at the Y direction which size is 41 and at Z direction which size is 425 as the center of the circle, complete the sketch, subtract by Boolean operation, stretch the circle with diameter of 35 by 218 and the circle with diameter from 50 by 88. Draw two circles of 24 diameter with the positions of X direction which size is 50,50 and Y direction which size is 153, 323 respectively as the center of the circle, complete the sketch, subtract by Boolean operation, and stretch the size of 82 from fig.19.

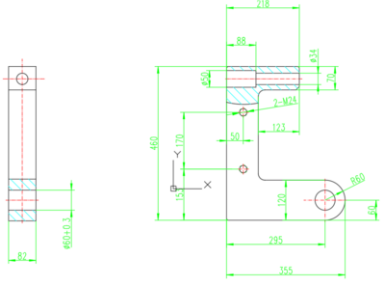

Fig. 18. 2D diagram of locking mechanism moving block

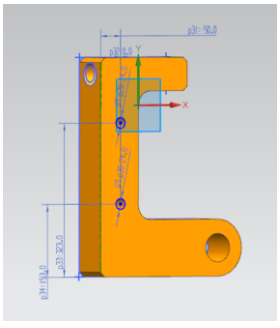

Fig. 19. Locking mechanism moving block

Figure 20 shows the schematic diagram of the final assembly size of the lifting platform. Assemble the parts together and constrain the size position, as is shown in Figure 21.

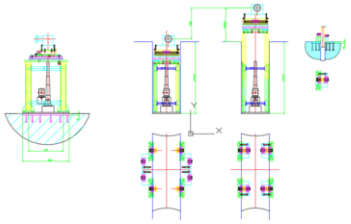

Fig. 20. General assembly drawing of dynamometer

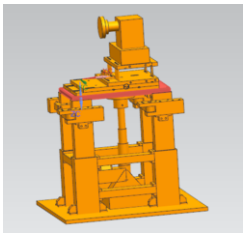

Fig. 21. Assembly drawing of dynamometer lifting platform lifting platform

3. Dynamometer Physical Operation Demonstration

3.1. Rising and Falling Functions:

The ascending and descending functions of the equipment are realized by the positive and negative rotation of the driving motor of the electric push rod.

- 1)Speed adjustment function of the lifting platform:

The speed adjustment function of the equipment is adjusted by the potentiometer knob on the frequency converter panel on the operating handle.

- 2)Locking function of lifting platform:

The locking function of each function board of this equipment is realized by bolts and nuts. In the working state of dynamometer, the locking of moving column is realized by the locking mechanism.

- 3) The lifting and lowering limit function of the lifting platform:

The lift and fall limit function of the lifting platform is realized by two travel switches installed on the electric push rod.

3.2 Rise Function:

As is shown in Figure 22, turn on the power and check that the lifting part is normal before moving the lifting platform. To turning the direction knob on the manual control panel to the upper position, and then adjusting the transducer potentiometer knob to the appropriate Hertz, frequency adjustment range is 0~20 Hz, and then turn the switch knob to the open position, the lifting platform began to rise. If the frequency converter panel has no frequency value display in the work, please press PROG key several times, the frequency value display can be displayed.

Fig. 22. The dynamometer device button diagram

The adjustment steps are as follows:

After rising to the connection position, turn the switch knob to the off position, it can start to adjust the swing angle, front and back position, left and right position, and pitch angle.

- 1) Adjustment of swing angle

Loosen the four fixing bolts on the base plate of the fifth layer and the fastening bolts on the fourth layer, as is shown in fig.23, and to loosen the rotary shaft nut. As is shown in fig.24, the adjustment screw on the adjustment mechanism of the swing angle can adjust the swing angle. After the adjustment, lock the loosened bolts and nuts, and to adjusting the swing angle.

Fig. 23. Fastening bolts

Fig. 24. Rotating shaft nut

- 2) Adjustment of front and rear positions

As is shown in Figure 25, to loosening the fastening bolts connecting the fixed swing angle plate of the fourth layer plate and the front and back moving plate of the third layer plate, and adjusting the adjusting screw on the front and back adjusting mechanism, as is shown in Figure 26, to realize the adjustment of the front and back positions. After the adjustment is complete, to locking the loosened fastening bolts and to adjusting the front and rear positions.

Fig. 25. Fastening bolts

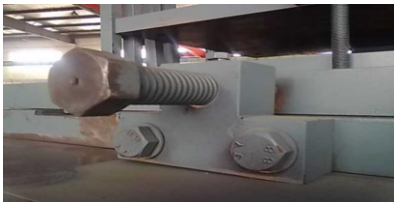

Fig. 26. Adjusting screws

- 3)Adjustment of left and right positions

As is shown in Figure 27, the fastening bolts connecting the fixed front and rear moving plates of the third layer and the translational plates of the second layer can be loosened, and the adjusting screws on the left and right adjusting mechanisms can be adjusted, as is shown in Figure 28, so that the left and right positions can be adjusted.

After the adjustment, lock the loosened fastening bolts. The front and rear positions are adjusted.

Fig. 27. Fastening bolts

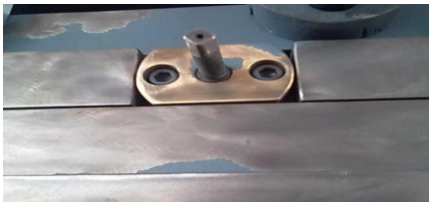

Fig. 28. Adjusting bolts

- 4) Adjustment of pitch angle

As is shown in figure 29, to loosening the fastening bolts on the connecting plate of the first layer plate and the connecting plate of the second layer translation plate, and adjust the adjusting screw installed on the first layer plate, as is shown in figure 30, to realize the adjustment of the pitch angle. After the adjustment, lock the fastening bolts on the loosened connecting plate. The pitch angle is adjusted.

Fig. 29. Adjusting screws

Fig. 30. Tightening bolts

- 5) The locking of the lifting platform

After the dynamometer is connected to the rear end of the vehicle gearbox through the universal shaft for accurate positioning, the locking mechanism on the edge of the trench is used to install and lock the 4 moving columns. As is shown in Figure 31, close the moving part of the locking mechanism first, tighten it with the fastening bolts, as is shown in Figure 32, and then tighten the four fastening bolts. The ascent and position adjustment steps are completed. It is start to trial work.

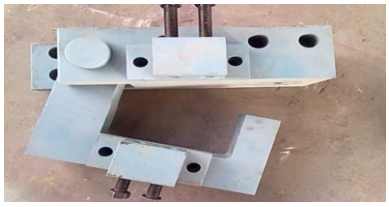

Figure 31. Locking mechanism

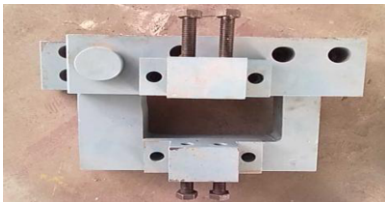

Figure 32. Fastening bolts

3.3 The Descending Steps Are as Follows:

Firstly, loosen and tighten the 4 moving column locking bolts, and open the locking mechanism. Secondly, in the case of confirming that the locking mechanism is open, turn the direction knob on the manual control panel to the lower position, then adjust the frequency converter locator to the appropriate Hertz, frequency adjustment range is

0~20 Hz, and then turn the switch knob to the open position, the lifting platform begins to fall. Figure 33 shows the real picture of the developed lifting platform.

Fig. 33. Real picture of lifting platform

4. Conclusion

In this paper, through the UG software to draw the structure of the whole vehicle thermal balance lifting platform parts, complete the overall assembly, finally put into the actual production, through the actual production verified that the structure design is reasonable, it is to solving some technical problems [7-10].

Acknowledgements

This research was supported by Natural Science Research Project of Universities in Anhui Province of China. The project name is Research and development and application of a new vehicle heat balance test bench lifting platform based on KBE. (Grant No. KJ2019A1165).

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