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PROBLEMS ANALYSIS AND COUNTERMEASURES IN THE OPERATION OF CONCRETE SPREADER

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Abstract: *The multi-spiral concrete spreader has the advantages of good operability, high efficiency and advanced automation performance. However, there are many moving components in the machine with complicated operation sequence and many sealing points of parts in the spreading process, therefore causing a series of common problems, such as buckled plate, blocked seals, stuck spiral, stalling motor, and spreading gate failure. Based on the daily running condition, this paper investigated the causes of common problems in the concrete spreading process and proposed corresponding solutions, which has practical guiding significance for the structure optimization and upgrading of the spreader.*

Keywords: *concrete spreader, common problems, countermeasures.*

1. Introduction

The concrete spreader is an important equipment in the production line of prefabricated concrete components.

The performance of the concrete spreader will affect the production efficiency of the whole production line.

Multi-spiral concrete spreader has the advantages of strong adaptability to concrete, good operability, high spreading efficiency and quality and advanced automation performance.

However, there are many moving components in the machine with complicated operation sequence and many sealing points of parts in the spreading process, moreover, concrete mortar has the characteristics of adhesion and water hardness, which inevitably leads to a series of common problems during operation, such as buckled plate, blocked seals, stuck spiral, stalling motor, and spreading gate failure. All these problems have increased the maintenance time of the machine and seriously affected the production efficiency.

Therefore, it is important to analyze the causes of these common problems and propose solutions.

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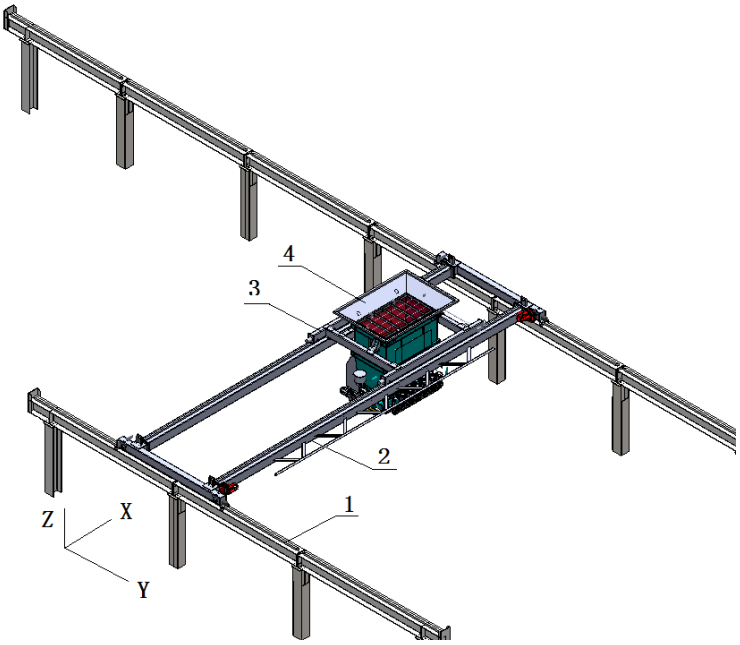
2. The Structure Characteristics and Working Principle of the Concrete Spreader

As an important equipment in the production line of concrete prefabricated components [1-2], the main function of concrete spreader is to homogenize the concrete through the dispersing device, and uniformly output the concrete into the mold through the conveying device under the distributor. The structure is shown in Figure 1.



1-frame, 2-cart, 3-trolley, 4-dispersing device

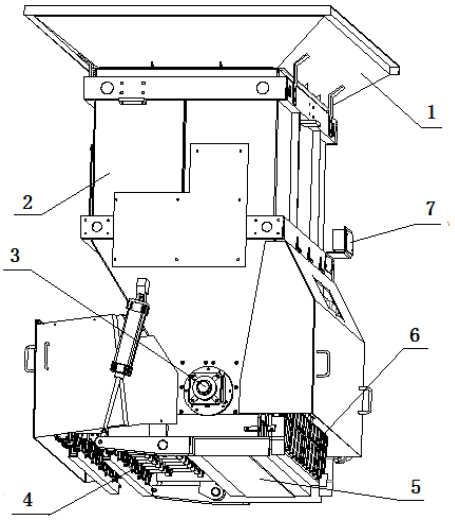
Fig. 1. *The structure of concrete spreader*

The cart is driven by two motors and can walk along the frame in the Y direction, and the parallel track on the cart serves as the route for the trolley. The walking trolley is driven by a motor with shaft and clutch along the track in the X direction. Two liftable hydraulic cylinders are installed vertically with 3 supports for connecting the fixed distributor and the weighing indicator. The dispersing device is used to carry concrete and implement the spreading process. It is mainly composed of a funnel-type feeder, a casing, a concrete conveying device, a scatter device, a pneumatic gate, a bottom plate, and a weighting sensor, as shown in Figure 2.

According to the spreading mode, the concrete conveying device can be divided into spiral conveying and spider shaft conveying. The spiral conveyor arranges with multi spirals within the spreading limits, and each spiral is driven by a separate convertor motor, which can be separately driven and adjusted to meet the requirements of spreading accuracy.

This type of spreader is known as multi-spiral spreader. The working process of the spreader is as follows: the lubrication device is enabled before starting the concrete spreader to ensure that the oil can continuously lubricate the spiral shaft.

Then the concrete feeder is moved to the feeding position to receive the concrete. The cart and trolley are moved to the desired spreading area using remote controller. Open the pneumatic gates, the number of which is calculated according to the required spreading width.



1- funnel-type feeder, 2-casing, 3- scatter device, 4- conveying device, 5-bottom plate, 6- pneumatic gate, 7-weighting sensor

Fig. 2. *The dispersing device*

At the same time, the conveying motors is started, and the concrete is slowly pushed out of the dispersing device by the spirals. The cart and trolley are moved again to complete the spreading work in all areas.

When all the precasted components are completed, the concrete spreader will be moved to the cleaning position, and then open all the gates and the bottom plate, and the residual concrete inside the spreader are cleaned with a high-pressure water gun for the next round of work.

3. Operating Problems and Solutions

3.1. Buckled plates of the spreader

In order to improve the corrosion resistance and wear resistance inside the spreader, the Teflon plates are usually used as the under boarding. Due to the long-term soaking in wet concrete slurry, some of the glued joints are separated from the outer casing, and the Teflon plates are buckled, as shown in Figure 3.

The solidified concrete is stick between the plate and the feeder, which results in erroneous measurements of the weighing sensor and causes great trouble for the cleaning work after each use.

Fig. 3. *Buckled plate*

3.2. Blocked seal rings of the spiral shaft

The lip-type packings are used in spiral conveyor as the seals, and some of the mud will enter the sealing ring in the case of vibration. It is impossible to do the internal cleaning of the small sealing rings with small oil outlet; therefore, the concrete slurry will dry and harden in the rings and stick to the spiral shaft when the machine stopped. The hardened concrete will clog the shaft and jam the spiral.

3.3. Motors stalling

There are two cases of spiral jamming: one is happened at the startup, and the other is during the spreading process. The former case is because the solidified concrete is stick to the spiral conveying shaft and interferes with other parts of the spreader to stop the motor. There are two reasons for the latter case: First, the concrete is mixed with large stones, which are stuck in the middle of the two spiral shafts. The spiral shaft cannot send the stones out, which causes the motor to stop.

This situation will result in motors stopped in pairs, as shown in Figure 4; the second is that the concrete water has poor fluidity with small water cement ratio. If several outlet gates are not opened for a long time, the concrete in this area will gradually become solidified and prevent the spiral shaft from rotating, causing the motor to stop.

3.4. Outlet gates failure

The concrete spreader implements the remote control to open and close the outlet gates, and each gate is represented by a control buttons on the remote controller. The operator can control the spreading amount of concrete by controlling the gate flexibly with proper water-cement ratio. However, when the water-cement ratio is relatively high, the concrete will have good fluidity and result in excess spreading after the

operator closes the gates. Manual handling of excess concrete is required, thus increasing the time of the entire spreading process.

Fig. 4. *Locked stone between the two spiral shafts*

4. Solutions

4.1. Solution for buckled plates of the spreader

The plates will be fixed with screws. All the plates should be removed and clean up, and straighten the curved ones. Then the straighten plates will be installed according to the original position, and assemble and drill at the same time to ensure that the holes on the plates align with the holes on the frame. The rubber washers are added under the screws to prevent concrete from flowing out of the gaps in the holes. The gaps between the plates will be filled with glues to ensure that the plates are fixed firmly, and the concrete will not flow out.

4.2. Solution for blocked seal rings of the spiral shaft

In order to discharge the internal slag of the seal rings, a threaded hole is drilled beside the oil hole, and blocked by a screw plug which will be removed if needed. The motor is started to rotate the spiral shaft, and the solidified concrete is crushed with a pencil rod with oil injecting into the slag hole. As the spiral shaft rotates, the fresh oil will be brought in and the waste oil will be discharged, thus achieving the purpose of cleaning the blocked seal rings. The slag hole is shown in Figure 5.

Fig. 5. *Schematic diagram of slag discharge hole*

4.3. Solution for motors stalling

For solving the spiral jamming condition at the startup of the spreader: First, by opening the gate to observe whether or not the solidified concrete is stick to the spiral shaft, and cleaning the solidified concrete. Next, check if there is internal slag in the sealing rings and prevents spiral shaft from rotation. Opening the slag discharge hole and clean it up. Finally, check the working condition of the motors.

For solving the spiral jamming condition during the spreading process: Stop using the stopped motors when the concrete material is mixed with large stones, the bottom of the spreader is opened to take out the large stones during cleaning. There are two solutions for motor stalling caused by gradually solidified concrete: one is to add water from above the spreader, and use vibration to increase concrete fluidity, so that the concretion is discharged and the motors are recovered back to normal working condition; The other one is to uninstall the concrete spreader out of the spreading station, open the bottom plate, take out the semi-solidified concrete, and restore the rotation of the spiral shaft.

4.4. Solution for outlet gates failure

Using an emergency button on the remote controller to close all the outlet gates immediately by reprogram the PLC. The button function is: when it is necessary to close the gate, no matter how many gates are opened, as long as the emergency button is pressed, all gates are closed at the same time.

5. Conclusion

The concrete spreader is an important equipment in the production line of prefabricated concrete components. The performance of the concrete spreader will directly affect the quantity and quality of the component. Multi-spiral concrete distributor has the advantages of strong adaptability to concrete, good operability, high

spreading efficiency and quality and advanced automation performance. However, there are many moving components in the machine with complicated operation sequence and many sealing points of parts in the spreading process, which inevitably leads to a series of common problems during operation, Therefore, it is necessary to monitor the operation status of the concrete spreader, summarize the common problems that often occur in the operation, and try to eliminate hidden dangers in advance, prevent major accidents from being released, improve the operation performance of the equipment, and provide guarantee for the efficient operation of the production line.

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References

1. Defang Zou, Peng Zhou, Jian Sun, etc.: *Introduction of Technique of Large and Intelligent Production Line for PC Slabs and Set of Equipment.* In: China Concrete and Cement Products, 2017 (4), p. 37-41.
2. Rongwang Xi.: *A Brief Discussion on the Common Problems of the Adjustment of Concrete Distributing Machine.* In: New Technology & New Products of China, 2017 (7 second), p. 43-44.