EcoDriveCN AC variable speed drives (frequency inverters, VSD, VFD, AC drives, variable frequency drives) of applications on knitting machine

In textile industry, many machines are used, including circular knitting machine and large-diameter single-cylinder circular knitting machine.

Scene:
Commissioning of machinery and equipment: circular knitting machine
EcoDriveCN Frequency inverter model: V5-H-4T-5.5G/7.5L (380V – 480V, 5.5kw for normal duty, 7.5kw for light duty)

Introduction of industry:
Circular knitting machines are already widely used in the textile industry. In the knitting machine industry, the potential of EcoDriveCN AC frequency inverter is quite large.

System solution and system wiring:
Currently, there is a mature control system for knitting machine. Basically the system is using Single-Chip Microcomputer (SCM) control, or PLC + HMI control. Its functional requirements of frequency inverter are very simple: only need to control the start and stop terminals, frequency setting using analog or multi-range frequency setting.

In the control performance, it requires frequency inverter can provide large torque at low frequency, because weaving load is heavy, and requiring the quick response to jog operation.

Here we use EcoDriveCN V5-H sensorless vector control (field oriented control) variable frequency inverter (E5-H PID closed loop control and optimized V/F control frequency inverters can be used for this too), improve the stability of motor speed and large torque output at low frequency.

Knitting machine requires the absolute prohibition of inversion and rotary phenomena of motor. Otherwise, the needle bed will be bent or broken. For knitting machine with a one-way bearing system, this impact can be ignored. If the forward or reversion of the system is entirely dependent on motor control, it needs to adopt proper DC braking function.

In speed control, the system requires at least three-stage speed operation.

1, jog operation, the frequency of 5Hz - 6Hz or so;
2, high-speed of normal weaving operation. The highest frequency is up to 80Hz;
3, low speed of take-in (put away) operation. When woven cloth reaches a certain length, need to slow down at the speed of around 20Hz to take in the cloth.

For multi-speed control, at the moment, there are two control schemes.

One solution is to set the frequency with analog signal. Whether it is jog operation, or running at low speed or high-speed, analog signals and run commands are given by the control system;

Another solution is to use the built-in multi-stage frequency setting of frequency inverter. The control system offers the switching signals of multi-step frequency. The jog operation is controlled by the jog function of frequency inverter itself. The frequency of high-speed weaving is given by the analog signal, or digital signal of open-loop frequency of the inverter itself.

Commissioning steps:

According to the motor nameplate, set the motor parameters, and use the rotation self-learning of parameter

P0.03=4 (process open loop control);

P0.04=1 (analog signal with AI1 terminal. If you set P0.04 = 2, then use analog signal from AI2 terminal. If set P0.04 = 3, use analog signal from AI3 terminal. If set P0.04 = 4, use pulse value from DI terminal. If set P0.04 = 0, frequency is set by the value of the parameter P0.05.);

P0.06=1 (setting mode of running command by the terminal);

P5.00=2 (the motor is running at direction of FWD);

P0.08=5 (acceleration time: 5 seconds);

P0.09=0.8 (deceleration time: 0.8 second);

P0.11=65 (max output frequency: 65Hz);

P0.13=65 (upper output frequency: 65Hz);

P0.10=0.5 (S curve time; 0.5 second);

P3.03=0.2 (starting frequency: 0.2Hz);

Pd.09=50 (braking torque limitation: 50%);

Pd.14=0.1 (pre-excitation time: 0.1 second);

PA.09=1 (dynamic braking enabled. If PA.09 = 0, dynamic braking is disabled.);

Pd.01=0.8 (speed loop proportional gain 1);

Pd.03=1 (speed loop proportional gain 2);

Pd.05=50 (automatic speed regulator (ASR) switching frequency);

Pd.17=10 (slip compensation gain under vector control 2, motor-driven);

Pd.33=0 (torque limitation compensation factor in constant power area);

P3.05 = 2 (stop mode: deceleration stopping and DC braking);

P3.06 = 0.5 (starting frequency of DC braking: 0.5Hz);

P3.07 = 120 (current of DC braking: 120% rated current of frequency inverter);

P3.08 = 0.5 (time of DC braking: 2s).

At the beginning, P0.11=65 (max output frequency: 65Hz), and P0.13=65 (upper output frequency: 65Hz). After the knitting machine has run for some time, the maximum frequency can be gradually increased to 80Hz, that means you can set P0.11 = 80 and P0.13 = 80.

Setting parameters: P3.03, Pd.09 and Pd.14, is just to improve the dynamic performance of start and stop time of knitting machine.

Knitting machine requires **faster response when starting, and large torque output at low frequency**. And it also requires smooth and soft shutdown to protect the needle bed.

So the starting frequency is decreased to 0.2Hz, reduce pre-excitation time of vector control to 0.1S, meanwhile setting 0.5 second S curve in time. That ensures the smoothness of frequency regulation during the start and stop time, then reduce the braking torque to 50%. After repeated experiments, this group of parameters achieves a good control performance.

These function codes (Pd.01, Pd.03 and Pd.05) are used to improve the vibration problem when the knitting machine is running at high speed.

Through increasing the automatic speed regulator (ASR) switching frequency, and reducing the speed loop proportional gain, it reduces the torque output at high speed of frequency inverter,

and reduces motor jitter, thus improving the strong vibration problem of the entire machine when running at high speed.

Parameter Pd.33 is to reduce the output current of constant power operation.

Site commissioning solution:

1. Question of choosing control mode: *vector control 1 or vector control 2?*

The requirement of knitting machine is not high for control performance of frequency inverter. Generally, the use of vector control 1 should be enough. **EcoDriveCN** V5-H sensorless vector control frequency inverter (frequency converter) can better improve the high torque output for low frequency and steady speed performance of knitting machine. Especially the feature of large torque at low frequency is excellent.

But during site commissioning, we found that running the frequency inverter under the control mode of vector control 2, with DC braking function, rotary phenomenon can be eliminated or improved a lot. So all **EcoDriveCN** frequency inverters for knitting machines use the control mode of vector control 2.

2. The motor shaft has a slight rotation for start and stop momentary

For circular knitting machines with the installation of a one-way bearing, that slight rotation can be ignored. But for some knitting machines, which have no mechanical prohibition of reversion, and fully depend on the control of motor, the slight rotation must be considered seriously. Because the slight rotation will damage the needle bed of knitting machine.

Here, DC braking parameters need to be set, in order to ensure that the use of DC brake will brake the inertia of the motor shaft fully during stop. Meanwhile, they ensure the angle of starting point of motor shaft is consistent with that angle the PWM wave emitted, thus solving the rotation issue of motor shaft at start momentary.

P3.05 = 2 (stop mode: deceleration stopping and DC braking),
P3.06 = 0.5 (start frequency of DC braking: 0.5Hz),
P3.07 = 120 (current of DC braking: 120% rated current of frequency inverter),
P3.08 = 0.5 (time of DC braking: 2s).
When the machine is stopped, DC braking operate at 120% rated current of frequency inverter, 0.5Hz DC braking begins, continuous braking time 2s.

After setting the DC braking function, basically it's able to reduce the motor shaft rotation problems to a minimum extent for start and stop momentary. That's better than many other brands.

What's more, **we can customize for our clients to reduce costs**.

For example: knitting machine has a set of mature control systems. Now, the common control systems are basically using touch screen + PLC control. But the cost of PLC controller is a bit high.

Through RS485 communication, our frequency inverter can be combined with touch screen (HMI), completely eliminating common PLC. This can greatly reduce the cost of knitting machine system.

Some competitive advantages for your reference:
Failure rate < 1%, similar as Siemens, Emerson Control Techniques, ABB, Danfoss, Eaton, Schneider, Allen Bradley, Lenze, Yaskawa
Authorized CE by ECMG
Under the audit of **NVLAP**. NVLAP Lab code: 200068-0. ISO/IEC 07025:1999, ISO 9002:1994
18-month warranty period
Prompt delivery lead time: 1-3 days
Supply to REGAL, Ingersoll Rand, Foxconn, CG Group...

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Simple introduction of company:
V&T Technologies Co., Ltd. is engaged in **variable speed drive (frequency inverters, variable frequency drives, VSD, VFD, AC drives, frequency converters), servo drive, motor soft starter, inverter, and other power electronics.**

The variable speed drives (frequency inverters) are used for **motor control, motion control,**

energy saving and process control: plastic injection molding machine, machine tools, **air compressor**, water supply, civil engineering, conveyor belt, **sewage disposal (wastewater treatment)**, **extruder (extrusion machine)**, fan and pump, HVAC, food and beverage industry, mining industry, **sugar industry**, etc.

As the leading and professional factory with best drives in China, we are competing with ABB, Siemens, Yaskawa in the world.

From 200VAC to 1140VAC, power is from 0.4KW to 3MW (0.5hp to 4000hp).