

## ALPHA Inverter Control Plan for Certain Paper Machinery in Changping

### I. Instruction

As an enterprise of high energy consumption, every ton of paper produced by the papermaking enterprise has to consume more than 500 kilowatt hours of electricity, which is very serious energy consumption. However, speed control of papermaking machinery has always been a weak link in the papermaking industry. The papermaking process requires the linear velocity of various parts to be absolute synchronous under their respective synchronous frequency points, and only in this way can the paper be ensured to be smooth, have even thickness, have no wrinkle or snap. In addition, the speed, stability and adjustability of the machine have a direct impact on the output and quality of paper.

Traditional papermaking machinery has adopted SCR DC (direct current) speed regulation and slip motor (small power) drive. Although the DC excitation motor has various advantages such as great adjustability and big start torque, it also has many shortages: high cost, difficulty for maintenance of the commentator and brush, difficulty to be applied in severe environment, and big noise which is not applicable in operation. In order to reduce energy consumption, optimize the product quality and increase labor productivity, modern papermaking equipment tends to adopt multi motors to drive the machine, i.e., each drive part is installed with an AC (alternating current) motor and equipped with corresponding inverter, which requires each part be able to realize synchronous control and speed regulation within certain scale.

### II. System Requirement

In order to manufacture products with high quality and standard, the papermaking machinery has the following process requirement for the drive system:

- a. The operating speed of the papermaking machinery should have a wide scale for regulation: in order to make the papermaking machine to have strong adaptability for product and material (such as beating degree, pulp ratio and category, quantity and paper category), the driving system of the papermaking machinery should be able to evenly regulate the speed in a wide range.
- b. The machine speed should have a high stability margin: the general speed should have stable increase and decrease. Speed of the papermaking machine tends to fluctuate due to various factors such as voltage and frequency of the power supply as well as the load of the papermaking machine. In order to stabilize the quantity and quality of the paper and reduce the paper web break, the papermaking machine should have stable speed.
- c. The speed ratio between various sections should be adjustable and stable. When there is change of load or other interference which have caused change of speed in certain parts, it should be able to be regulated timely, so that change of the section speed ratio won't surpass the rang of regulation.

- d. Single section point has the speed slight-increase and slight-decrease function as well as the paper clamping function during the paper injection operation. In addition, these sections also have single action and linkage function, and it can also start and stop at the same time. There is also necessary display, such as that of linear velocity, current, operation signal and failure signal.
- e. Separate fine tuning of various parts. For the convenience of overhauling, cleaning and examination of the operation of various sections, various sections should have separate fine tuning. In the meantime, during synchronous speed, various sections should be regulated at different values for synchronous control later.

### III. Control Plan

#### 1. Main circuit

This papermaking machine consists of the wire drive roll, vacuum couch, vacuum press roll, primary press, secondary press, drying cylinder 1, drying cylinder 2, drying cylinder 3 and collecting cylinder. It has 9 total transmission points, and various transmission points have adopted ALPHA6000 inverter to drive and realize stepless speed regulation.

#### 2. Characteristics of the ALPHA 6000 inverter

- \* Motor has been adopted to control the special 32-bit CPU;
- \* Special flux quantity control method;
- \* Great low-frequency characteristic, 150% high start-torque can be output at 0.5Hz;
- \* Wide voltage input, the fluctuation range is 304—456V;
- \* PID multiplex function, it can feed forward synchronous control;
- \* Complete over-current, overload and short circuit protection function;
- \* Comprehensive setting of multiple frequencies.

#### 3. Selection of inverters is as the following:

Attached Table: Power of Transmission Point and Inverter Model		
Transmission Point	Inverter Model	Motor Power (KW)
Vacuum Couch	ALPHA6000-37G	37
Wire Drive Roll	ALPHA6000-45G	45
Drying Cylinder 1, 2, 3	ALPHA6000-22G	22
Press Roll	ALPHA6000-30G	30

Collecting Cylinder	ALPHA6000-22G	22

#### 4. Schematic Diagram of the Main Circuit:

As shown in the FIG. below, the ALPHA6000 high-performance universal inverter and asynchronous motor have been adopted. One inverter is used to drive one motor. Before frequency conversion, each inverter is equipped with air switch for independent power supply, which is convenient for overhauling and debugging. Schneider air switches are used, which have complete and reliable short-circuit and over-current protection, plus the short-circuit and over-current protections provided by the inverter, it can reliably realize double protection for the system.

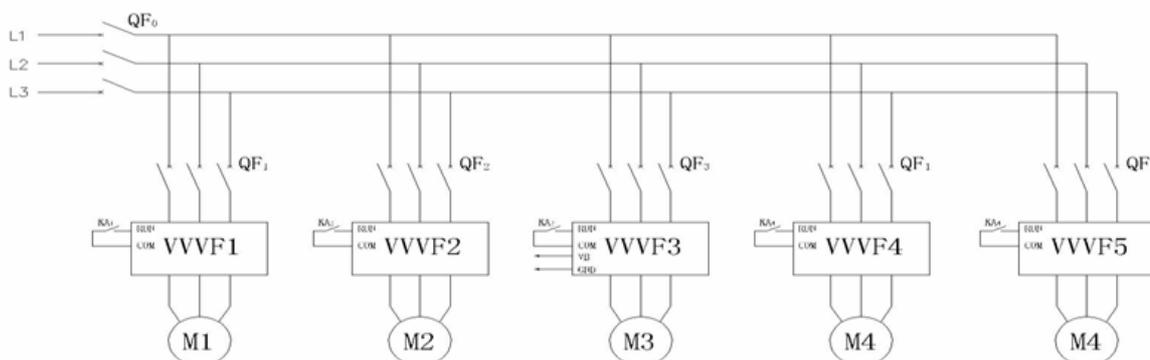


FIG. II

#### 5. Requirement for the control circuit:

- It can realize uniform speed regulation of the main transmission part within a big range, and various transmission parts should have synchronous speed.
- The speed should have high stability margin: increase and decrease of total speed should be stable. When there is change of load or other interference which have caused change of speed in certain parts, it should be able to be regulated timely.
- Various parts should have single action and linkage function for the convenience of overhauling and debugging.

#### 6. Synchronous Control and Fine Tuning of Various Sections

The wire drive roll inverter sets the system speed through the main speed setting potentiometer. Other inverters should realize cascade control with it respectively to respond to the speed of the wire drive roll and to guarantee the synchronous requirement of the system. In addition, the inverter of cascade control can independently realize fine tuning of speed, and after one inverter has realized fine tuning, the following inverter will respond and conduct automatic trimming, in this way to ensure synchronization. The wire drive roll and vacuum couch inverters can realize distribution control of the load.

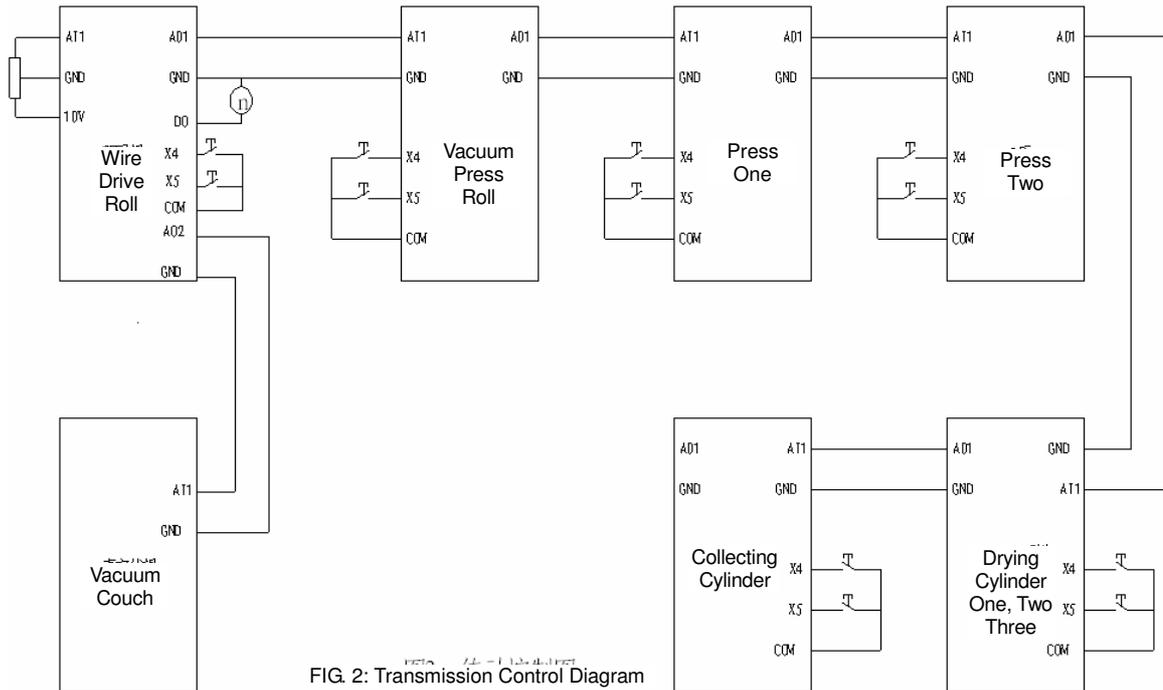


FIG. 2: Transmission Control Diagram

## 7. Setting of Main Parameters

Parameter	Set Value	Parameter Function
P0.01	2	The main frequency is set through AI1
P0.04	2	Terminal control mode 2 (STOP key is effective)
P3.03	10	UP function
P3.04	11	DOWN function
P4.17	9	AO1 output changes in accordance with AI1
P4.18	9	AO2 output changes in accordance with AI1

## IV. System Advantages

1. The inverter has a small size and a light weight, it does not need to be equipped with control panel, and it has simple installation and debugging, convenient operation, small noise and no vibration.

2. High precision of speed regulation, when there is change of load and network voltage (340—420V), the rotation speed of its motor does not change, so it has strong adaptability.
3. It has complete protection functions and high integration level, so it has high reliability. In addition, the inverter also has self-diagnosis function and convenient overhauling, which can significantly reduce the time to stop and increase the productivity.
4. It can realize stepless speed regulation and a small start current, which has no impact on the machinery and power system. It also has great energy conservation effects, and about 30% of energy can be saved.

