

Automatic Minor U Bender
(Operation Direction)

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1.Application

This is a very special machine in the copper U bender making of heat exchanger, which can realize the movement of feeding, clamping, bending , cutting and unloading automatically.

Main characteristics;

- 1) Adopts with automatic programming controller, including manual and automatic operation functions.
- 2) 3 pieces of works can be produced at the same time in one cycle.
- 3) Different U bender can be made by changing different spare parts.

(note: This machine only equips with one specification die when delivery, the customers have to buy the optional spare parts specially if needed)

2.Main Technical Data (Basic type)

- 1) Copper tube specification: 3/8" X 25
- 2) Bending angle: 180 degrees
- 3) Bending tact: 3 pieces at the same time
- 4) Time for one cycle: about 7-8 seconds

Oil Pump Motor Parameter: see the machine.

Cutter motor parameter: see the machine.

- 5) Cylinder
 - a. Bending swing cylinder: Φ 50x180mm
 - b. Feeding cylinder: Φ 40x135mm

- c. Shearing cylinder: $\Phi 40 \times 76 \text{mm}$
 - d. Pivot in and out cylinder: $\Phi 40 \times 70 \text{mm}$
 - e. Feeding clamping cylinder: $\Phi 40 \times 3 \text{mm}$
 - f. Bending clamping cylinder: $\Phi 40 \times 3 \text{mm}$
- 6) Oil Pump Cylinder
 - 7) See the machine.
 - 8) Max. working pressure of hydraulic system: 6.3 Mpa
 - 9) Air Pressure: 0.4-0.6Mpa
 - 10) Total weight: about 1300kg
 - 11) Whole size: 1700x1150x1650mm

3. Working Principle&Structure

This machine is comprised of machinery including machine body, bending mechanism, feeding mechanism, cutting mechanism, bending swing cylinder, cutting cylinder and pivot in and out cylinder, hydraulic system, electric controlling system and oil temperature cooling device.

1) Machine body

Machine body is welded by steel plate. Bending swing oil cylinder and material out leakage are installed in the vacuum space below Machine body. The oil tank is located in the back side, and equips with the hydraulic station.

2) Bending Mechanism

This part is comprised of gear, gear-mechanism, gear axis,

bending-arm, bending mold plate, bending mold seat, moving mandrel and bending mould rod fixed on the bending frame. While working, the bending mold plate will be swing around bending mould rod line, which will make form according to the reset requirements.

The main parts executing bending function include moving mandrel and bending mould rod fixed on the bending frame and bending mould around bending mould rod circle installed on the bending mould seat and bending mandrel for movement of forming after copper tube inserting.

3) Milling & Cutting Mechanism

This part is comprised of machine belt wheel, milling and seat plate etc (Note The seat plate can accord with the different size by moving up and down).

4) Feeding Mechanism

This part is comprised of clamping cylinder, bending clamping cylinder, guiding line, which can move up and down according to the tact and at the same time the two clamping cylinders will clamp or loose.

5) Oil Cylinder

Bending swing oil cylinder: This cylinder will pass the dynamic power to the bending mould seat by the forward of the rack structure and piston, which will make the bending mould returning and the U forming.

Cutting Oil Cylinder: Control milling Cutter is used to cut Copper tube and Cutter returning back.

Feeding Oil Cylinder: This part can make the feeding mechanism move up and down. The oil cylinder can accord with the different feeding length by adjustment during the oil cylinder travel.

Mandrel in and out Cylinder: This part is installed on the bending mould seat, which can not only move up and down by itself but also work around the bending mould rod and then bring bending mandrel go in and out the copper and form U bender.

Bending Clamping Oil Cylinder: Fixed before the bending mould rod which clamp the copper tube upon bending.

Feeding clamping Oil Cylinder: This part can not only move up and down in order to clamp or loose the copper tube but also can move up and down with the feeding cylinder.

6) Hydraulic system

The hydraulic system is made of oil tank, vane pump, motor, hydraulic valve group, hydraulic cylinder for each movement and other hydraulic accessories.

Hydraulic valve group: comprised of electromagnetic turning valve, electromagnetic overflow valve and single direction gate valve etc. The whole hydraulic valve has been set in the oil tank by the intergared type.

The water cooling device has been installed at the side of the oil tank, which can decrease the temperature of oil circuit, improve the working performance and efficiency.

7) Lubricating oil spraying device

This device is including oil fog generator, release valve & two electromagnetic air valve and compressed air circuit. Its function is to spray the oil fog and compressed air to the cutting spare parts subject to the production requirement, which elongates the milling cutter life, increases the finishing and the pivot lubricating.

4. Lubricating System

Please fill the lubricant in each spare parts in this mechanism, so that each part has a good lubrication, decrease the resistance and wear. The swing cylinder seat with gear and gear rack should be filled with Lithium lubricating grease every month. As for the feeding guiding line, copper sleeve and pivot in and out guiding line (6 oil spraying mouths) should be filled with 30# machinery oil each shift.

5. Electric Controlling System and Operation

1) Brief introduction of electric system: Adopts with OMRON programming controlling system, which is reliable in performance, high in automation and tight in structure. All the spare parts are installed in electric controlling box, the operation buttons and indicating lights are in panel of box.

The power supply is 3 phase, 4 wires, L1, L2 and L3 are connected, PE is connected with ground. The total power is 3 KW. The switch of total power is automatic air switch, and the switch of program controlling

power is 2 phase air switch.

2) Operation

Open the controlling box before operation, turn on the 3 phase air switch, then the indicating light is on. After that, press the start button of oil pump motor, oil pump starts (at this time, square type button should be in “auto” position, that is to say, in the unloading position, so that the overflow valve will start, which wastes the energy and make the oil pump heating)

Operation includes manual and automatic types. Manual type, only for beginning adjustment, preparation and checking. In the automatic type, there are two procedures, one is “recycling ”, another is “one round”, the former stands for continuous automatic recycling operation, the latter is finishing one automatic operation program.

a. Manual operation

Turn the operation button to “manual” position, Operation switch of material feeding clamping is in “release” position: feeding switch is in “back” position; Bending clamping switch is “release” position, milling cutter and mandrel switch are in “back ”position; bending switch is in middle position.

Turn the feeding clamping switch to “clamp tightly” position, feeding will be clamped tightly; Turn the feeding switch to feeding in position, then feeding in; Turn the mandrel to “in” position, the mandrel will enter

into the copper tube; Turn bending clamping switch to “clamp tightly” position, the bending will be clamped tightly; Turn the bending switch to “bending in” position, the bending will be executed. When the bending complies with the requirements, turn the mandrel switch to “mandrel back”, the mandrel will be out from the copper tube; Turn the feeding clamping switch to “release” position, feeding clamping will be released. Turn the feeding switch to “back”, feeding will be back. Turn the feeding switch to “clamp tightly” position, at this time, turn the bending switch to “reset” position, the bending will reset; When contact the stop travel switch in the middle of bending reset, the bending reset stops. Then, turn milling and cutting switch to “milling and cutting in” position, milling and cutting, as well as blowing air. When the milling and cutting get up the requirements, they will return back. Turn milling and cutting switch to “back”, and turn bending clamping switch to “release”, the bending clamping will loose, next, turn the bending switch from “reset” to “0”, then from “0” to “reset” (back), the reset is finished completely. During the time of no work, the operation button will be in “auto” position, which is the unloading conditions.

b. Automatic type

Turn the operation button “auto” position, (note: during the automatic type, beginning position of clamping, feeding, bending, mandrel in and out, cutting etc. cylinders are in “reset” position, that is to say, the travel

switch XK4 must be pressed, bending will return back to XK9, milling cutter will return back to XK8) .

Press “auto start” button, the machine will run automatically. The sequence is feeding clamping tightly-feeding in-mandrel into the copper tube-bending clamping-bending in (blow air)-mandrel out-feeding clamping loose-feeding back-bending reset and stop in the middle-milling and cutting (blow air)-milling and cutting back-bending clamping loose—bending reset completely-next recycle begins.

If the stop needed in automatic type, turn the rotating button (recycling and one round) to “one round” position. After the last movement, the machine will stop automatically. And will be into the unloading conditions.

c. The adjustment of counter

JS is electromagnetic counter, it has the function to count the quantity for works after bending. Before counting, please press the counter reset button to “0” in advance, then count.

d. Electric interlock and protection

The oil pump motor can be protected by the air switch 2K1 and hot relay switch TR from overload and short cut circuit. Regardless in manual or automatic condition, they will be interlocked together to protect the whole machine.

6. Installation, Adjustment and Commission

1) The machine base must be adjusted and fixed before the second filling so that the the working table is in level position. There is a small pit in the oil outlet for conveniece of oil changing. (note: we supply the iron gasket with the machine, no need to imbed the foot screw in advance)

2) Check every connecting place, especially the oil pipe, to avoid the leakage of oil and air.

3) The surface of oil in the tank must be in the range of oil position indicating meter. Lubricate every spare part subject to this direction.

4) Adjustment of cylinder travel

The Oil Cylinder beginning and end position should comply with the requirment of standard, which have been adjusted before delivery. But the user can adjust according to the following procedure.

Bending Swing Oil Cylinder: Adjusting the screw in both ends for oil cylinder, adjusting the damp pin three valves untill reach the right buffering and then select the exact beginning and end position.

Cutting Oil Cylinder: Adjusting the oil cylinder connetion and select the exact end position.

Mandrel in and out Oil Cylinder: Make the moving bending mandrel ball to the suitable position by adjusting right-angle connection seat position.

Selecting the suitable bending mandrel against different size work.

Feeding Oil Cylinder: The travel is controlled by adjusting screw at the

end, Control the end position by adjusting piston rod.

5) Adjustment of the position for moving bending mandrel

The opposite position of moving bending mandrel and bending mould rod is adjustable, the moving bending mandrel can move by adjustment. Checking the bending conditions after testing one recycle.

a) The bending mandrel is too long to make some corrugation on the working outward semi-circle. This problem can be solved by making the mandrel back by adjusting the right-angle connection back.

b) The work is not in one circle horizontally because the mandrel enter too short. This problem can be solved by making the mandrel forward by adjusting the right-angle connection forward

6) Adjustment of horizontal position for milling cutter.

This machine adopts the serration (Type GB1121-85) whose diameter is Φ 250mm including 300 teeth, 1.2mm thickness. The position of milling cutter can be adjusted horizontally by changing cutter axis gasket.

7) Hydraulic System Adjustment

The safety valve is around 3Mpa generally. If the system pressure is too high, it wastes electric power and makes the working temperature rising.

8) Confirm the rotating direction of oil pump

Firstly, press the oil pump button while electric power supply is connected, in order to confirm whether the rotating direction of oil pump

is in accordance with the requirement. If reverses, must change the phase of motor wire.

7. Testing without load

Must operate by manual step by step, transit the press button and make the stress observation: the electric program is right or not and machinery position and movement speed etc.

- 1) Turn the feeding clamping switch the clamping position and observe the clamping cylinder is clamped or not.
- 2) Turn the feeding switch to “on” position and feeding piston go forward.
- 3) Turn the mandrel in and out switch to “in” position, the mandrel go forward.
- 4) Turn the bending clamping switch “on” position and observe the clamping cylinder is clamped or not.
- 5) Turn the bending switch to “on” position, the bending piston will go forward and the oil spray out.
- 6) Turn the mandrel in and out switch to “back” position and mandrel will go back.
- 7) Turn the feeding clamping switch “back” position and the feeding clamping piston will be back.
- 8) Turn feeding switch to “back” position, feeding piston will be back.
- 9) Turn the bending switch to “bending back” position, bending swing

cylinder will stop in specific position during the course of reset.

10) Turn the milling and cutting to “on” position, the piston will be forward, the motor will start, the wind mouth will blow.

11) Turn the milling and cutting to “back” position, the motor will stop, the piston will return.

12) Turn the bending clamping switch to “release” position, the bending clamping cylinder will loose.

13) Turn the bending switch to “0” position, then turn it to “reset”, bending piston will get to the bottom completely.

After the whole manual operation is finished, please turn the operation button to “unload” position, then the hydraulic system will be in the unloading condition.

During the course of the above testing, make the oil cylinder move stable by adjusting the single direction gate valve, and no obvious impact. Meantime, it is necessary to check the electric interlock for milling and cutting from the beginning position to end position of the bending swing oil cylinder. Before milling and cutting oil cylinder forward (motor working), bending reset is locked. Otherwise, it is easy to damage the spare parts of the machine. Please pay attention to this point. Other oil cylinder should finish in and out movement without any difficulty by manual.

Test the manual recycling for several times, then test it by automatic “one

round”, test run without load, check the position of the travel switch.

8. Bending Test

1) Put 3 pieces copper tube into the feeding device by hand, the head of copper is uniform and the position is exact.

2) Turn the operation button to “manual” position, then process subject to the procedure.

3) Check the works quality after bending, then adjust the machine to make the works eligible.

4) Confirm the machine in normal conditions, turn the operation button to “auto” position, perform “one round” test. After eligible, into the “recycling conditions”.

9. Adjustment of works

Besides the basic type, this machine can produce different U bender subject to the requirements by changing or adjusting some spare parts. The specification of U bender after bending is different, but the copper tube specification is same. If copper tube specification is different, one machine only equips with only one die. The following spare parts need to be adjusted or changed (please refer to the diagram):

- 1) Change the bending mould rod and bending mould plate.
- 2) Change center adjusting plate and keys of mandrel in and out cylinder.
- 3) Adjust the feeding cylinder travel.

4) Adjust the milling cutter horizontal position.

After adjusting or changing of the above spare parts, must test run without load again and adjust the whole machine in accuracy.

10. Maintenance and Technical safety notice

1) While working , the operator must draw the safety cover down and must not face the milling cutter directly.

2)Hydraulic transitting media adopts 20# machinery oil(ISOVG32).
Changing the hydraul oil one time per half one year.

3)While changing the hydrylic oil, operator must notice three factors:

a.Clear the bottom of oil cylinder

b.Filter the new oil by the filter net whose filter density must exceed 180 μ and at the same time notice the filter core.

4) Non workding person is allowed to turn the overloading valve, single direction gate valve handle and other hydraulic units.

5)Before operating, the operator should check whether each oil cylinder is on the orginal positon or not and the fastness of the fixed units.

6)Before operating, the operator should check whether the hydraulic pressure system and air pressure is right or not.

7) Checking or repairing the vavle and pipe units is not allowed during working.

8)Operator must find faults and eliminate them during working.

9)Operator must shut down the power supply after operation is end.

10)The customer do not change the program at random which is adjusted and finished in the factory.

11.Rubber and plastic spare parts easy to break sheet, bearing sheet and other spare parts easy to break sheet.

Rubber and plastic easy to break sheet

Name	Type	Install cylinder	Remark
Dustproof ring	DH22(22*31*7.6)	Cut, mandrel, feeding cylinder	
Dustproof ring	DH18	Clamping cylinder	
O sealing ring	P22(21.8*2.4)	Cut, mandrel, feeding cylinder	
O sealing ring	P15(14.8*2.4)	Cut, mandrel, feeding cylinder	
O sealing ring	40*3.1	Cut, mandrel, feeding cylinder	
O sealing ring	50*3.1	Bending, clamping cylinder	
O sealing ring	25*2.4	Bending cylinder	
O sealing ring	P5(4.8*1.9)	Swing oil cylinder	
O sealing ring	P18(17.8*2.4)	Clamping cylinder	
O sealing ring	P44(43.7*3.5)	Swing cylinder	
O sealing ring	P44(13.8*2.4)	Swing cylinder	
Yx sealing ring for hole	D1-30(30*40*6.5)	Mandrel,cut,feeding cylinder, clamping cylinder	
Yx sealing ring for hole	D1-40(50*40*6)	Swing cylinder	
Yx sealing ring for shaft	UN22(22*30*6)	Cut,mandrel, feeding cylinder	
Yx sealing ring for shaft	UN18A(18*26*5)	Clamping cylinder	

Synchronization belt	225-L-100		
Guiding line material for machine soft belt	PTFE δ 2.5	Cut, feeding ,mandrel cylinder	Guiding line sleeve for cylinder

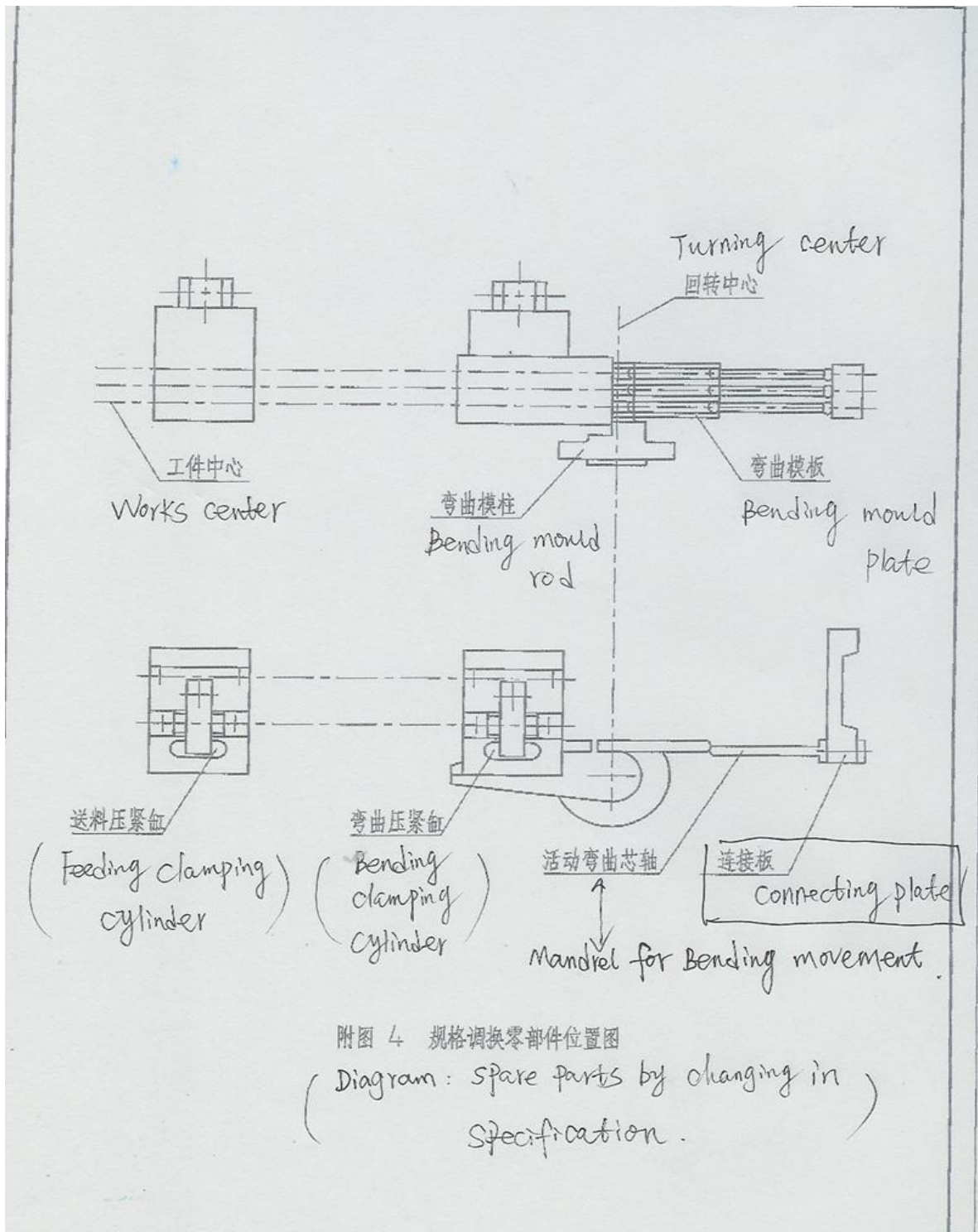
Bearing Sheet

Code	Name and Type	Remark
GB276-89	Single line centripetal force bearing 104 (D grade)	Milling cutter axis
GB278-89	deep groove ball bearing with dustproof cover 80210	Gear axis
GB278-89	deep groove ball bearing with dustproof cover 80208	Gear axis
	Bearing without oil SF-1 2525	Feeding components
	Bearing without oil SF-1 1825	Mandrel Guiding line
	Bearing without oil SF-1 1810	Clamping cylinder
	Bearing without oil SF-1 3020	Bending gear axis

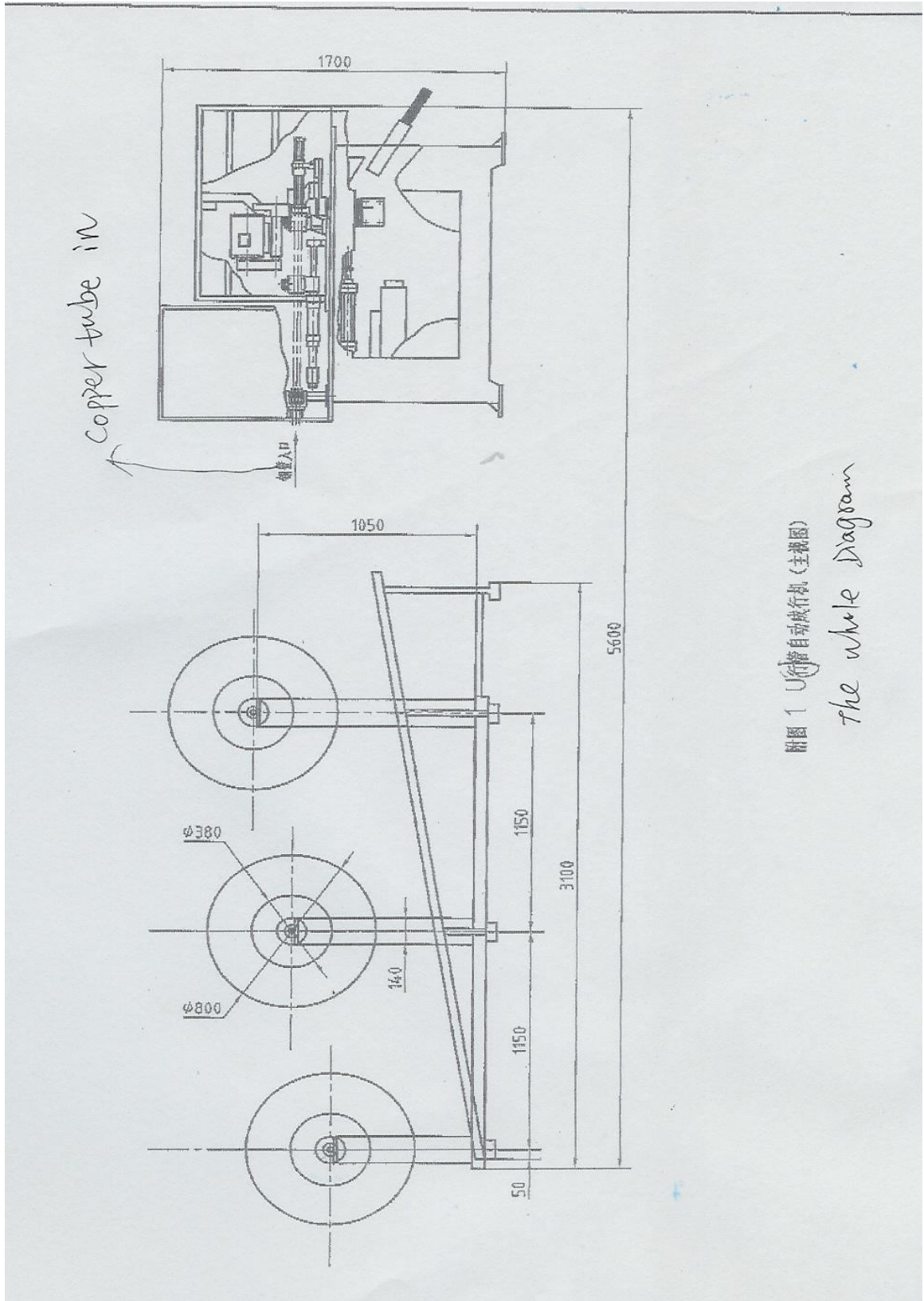
Other spare parts easy to break sheet

Code	Name	Remark
GB1211-85	Thin gear cutter piece milling cutter $\Phi 250 \times 1.2$ (300 teeth)	Purchase
1423-1-23	moving bending mandrel	Purchase according to specification

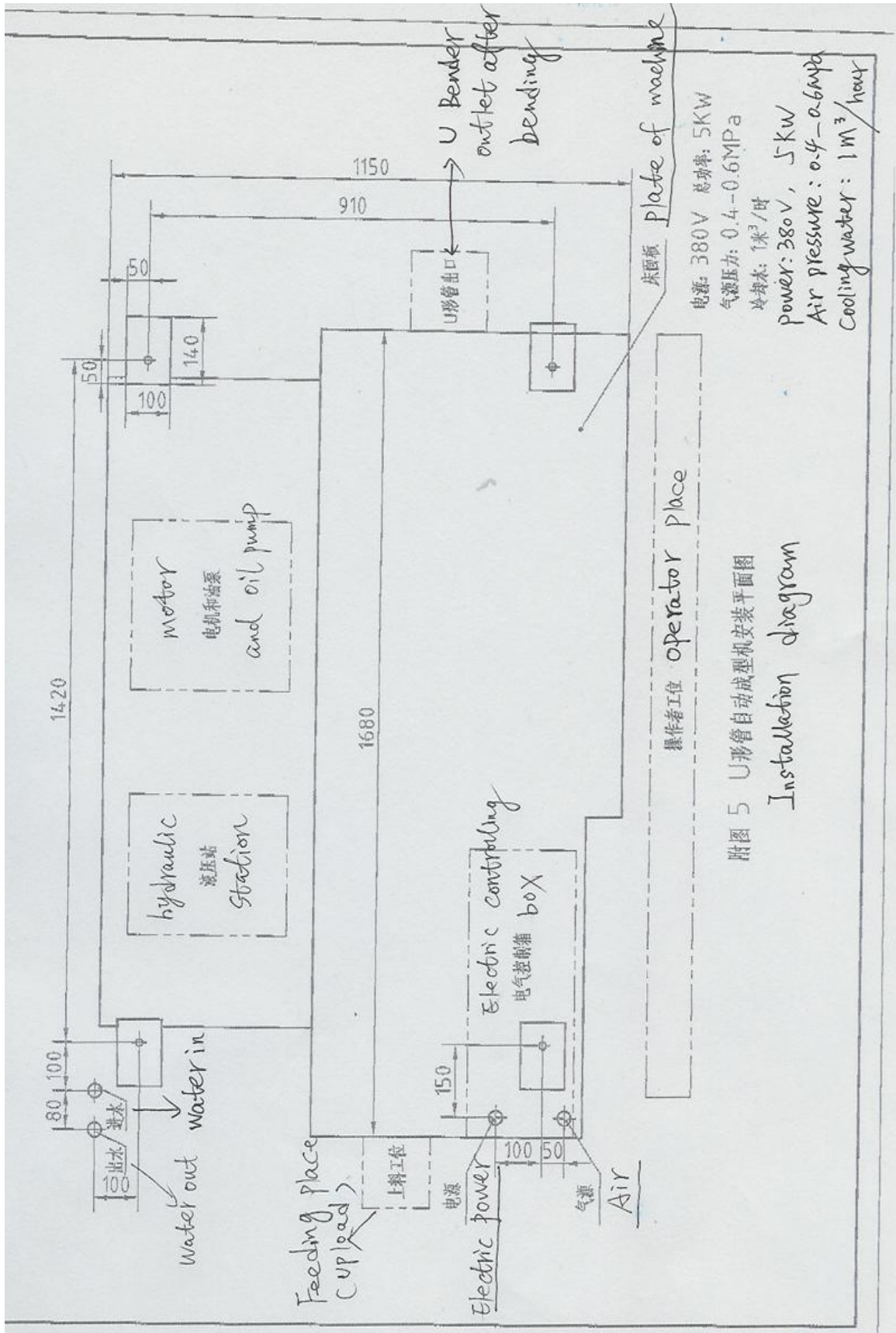
12. Diagram



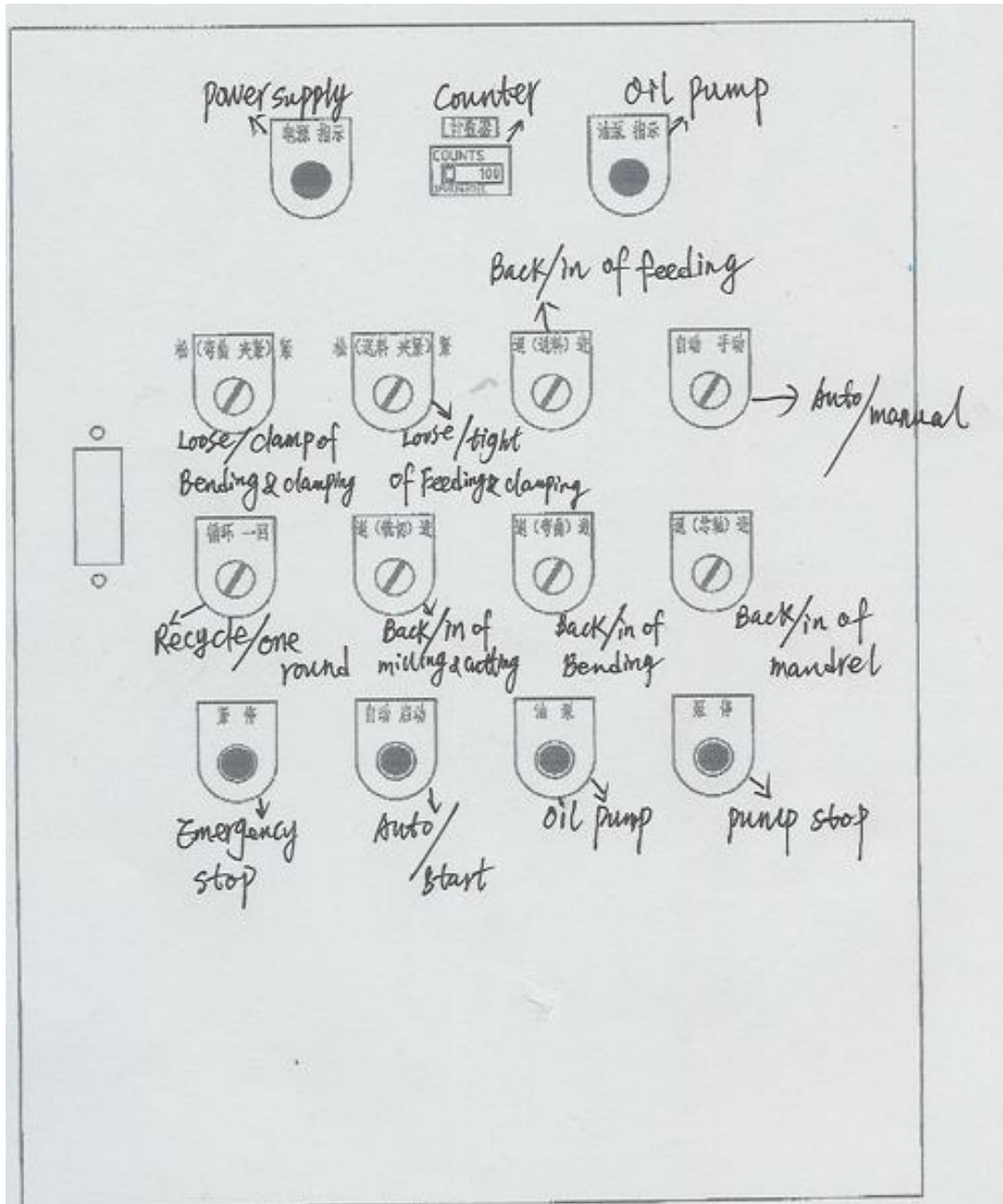
附图 4 规格调换零部件位置图
 (Diagram: spare parts by changing in specification.)



附图 1 U 形管自动成管机 (主视图)
The whole Diagram



附图 5 U形管自动成型机安装平面图
 Installation diagram

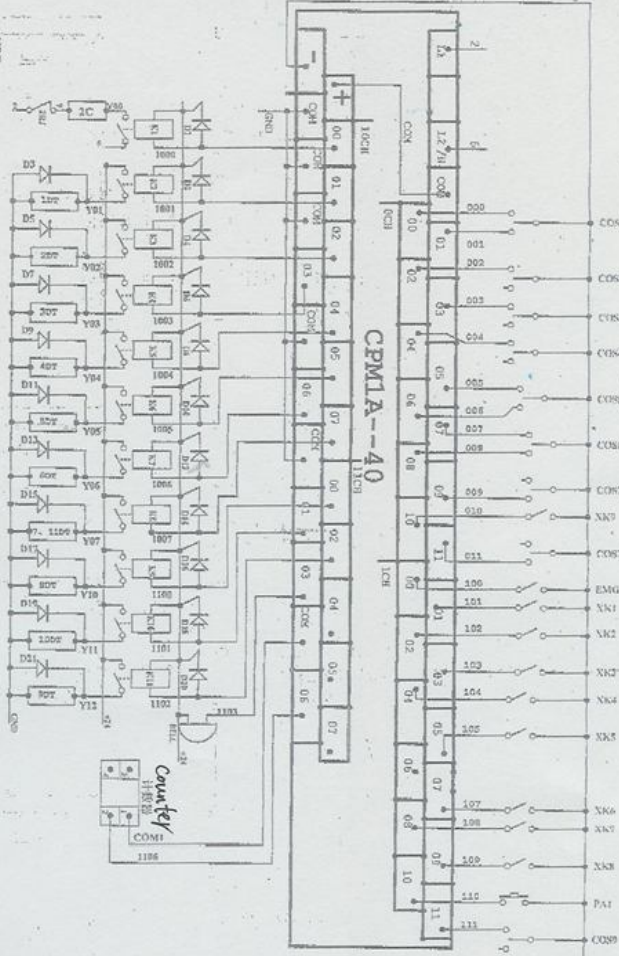
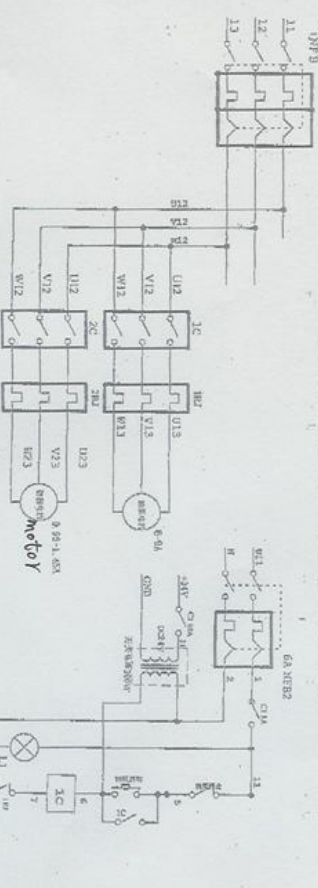


operation panel.

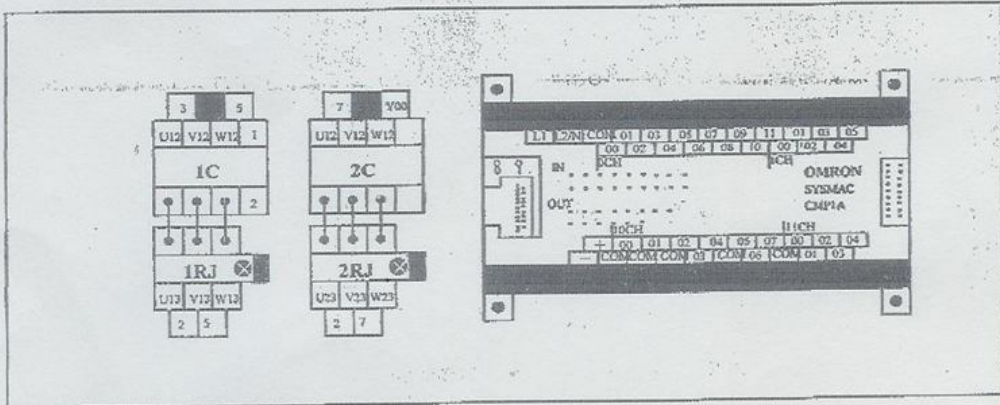
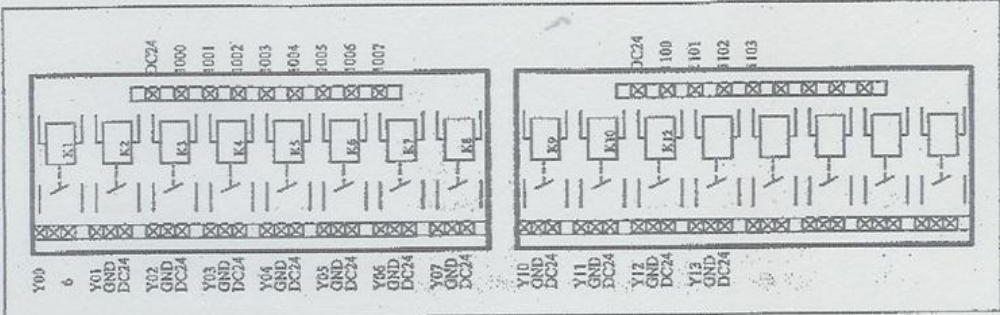
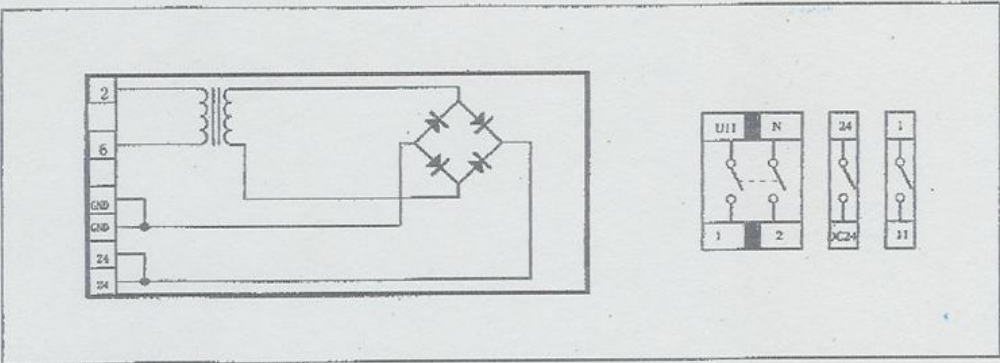
附图 6 操纵箱面板布置图

Electric Working Principle Diagram

图 3 小弯管电气原理图 (刹车料架)

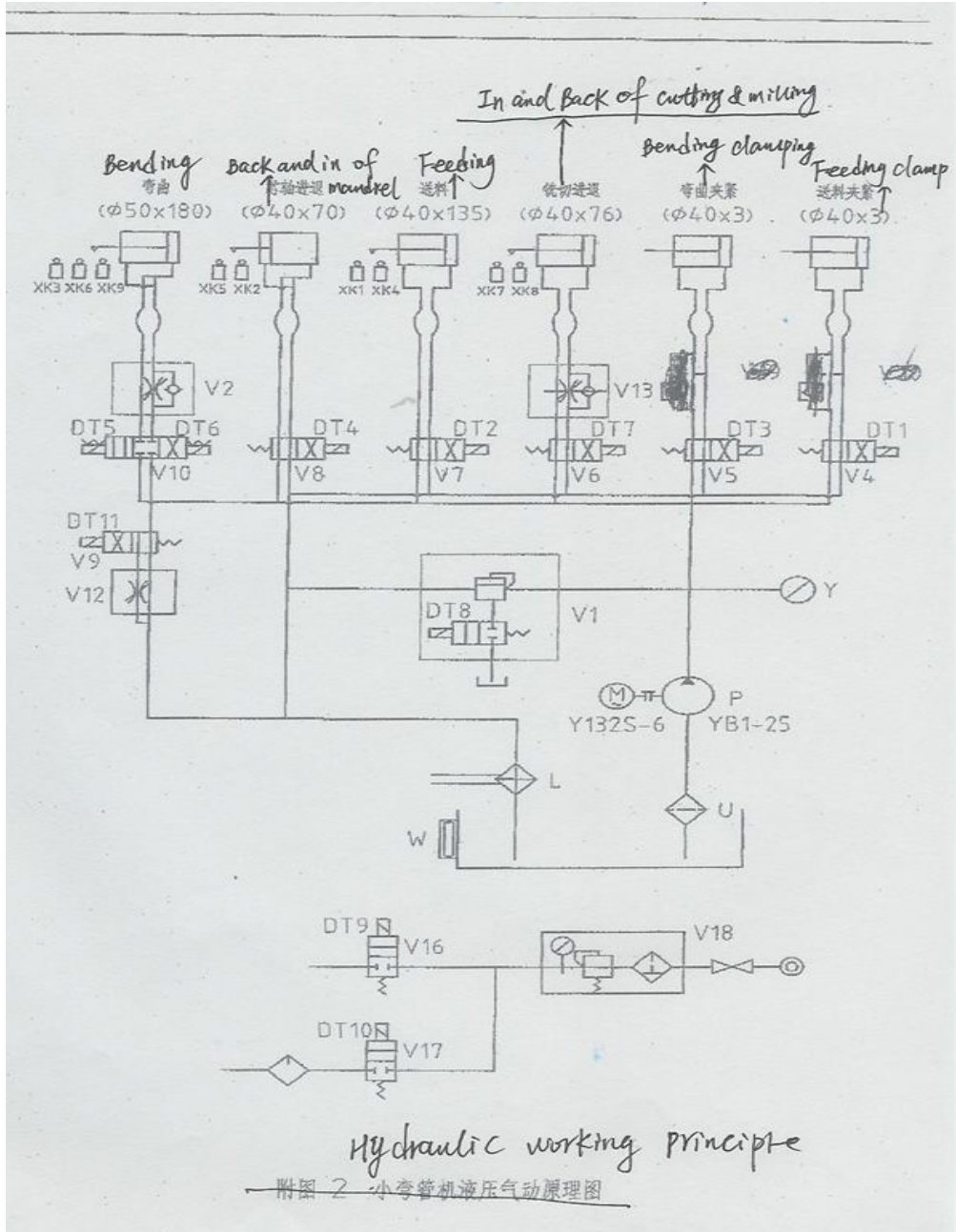


Input Address	Output Address
000 automatic cos1.1	1007 cutting & cutting in the position XK6
001 manual cos1.2	1107 milling & cutting in
002 Feeding clamp cos2	1100 Feeding clamp
003 Feeding in cos3	1101 Feeding in
004 Bending clamp cos4	1102 Bending clamp
005 Mandrel out cos5.1	1103 Bending in
006 Mandrel out cos5.2	1104 Bending in
007 Bending in cos6.1	1105 Bending out
008 Bending back cos6.2	1106 Warning out
009 cutting & cutting in cos7	1107 Emergency stop
010 Warning in XK9	1108 Mandrel stop
100 Emergency stop EMG	1109 Auto start PAI
101 Feeding in the position XK1	1110 recycle cos9
102 Mandrel in the position XK2	
103 Bending in the position XK3	
104 Feeding back the position XK4	
105 Mandrel back the position XK5	



L1	L2	L3	N	PE	U13	V13	W13	PE	V23	W23	I01	I02	I03	GND1	COM	I04	I05	I06	GND1	COM	I07	I08	I09	GND1	COM	Y01	Y02	Y03	GND	Y04	Y05	Y06	GND	Y07	Y10	Y11	Y12	Y13	GND
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Layout for horizontal Bending
 附图7.水平弯布置图



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