Specialty/Option: ELECTROTECHNICS

Paper: AUTOMATISM AND INDUSTRIAL COMMUNICATION **Duration: 6 hours**

Nature of Paper: Theory **CREDIT: 06**

AUTHORIZED DOCUMENT

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THEME: ROBOTIC PILING

I- DESCRIPTION

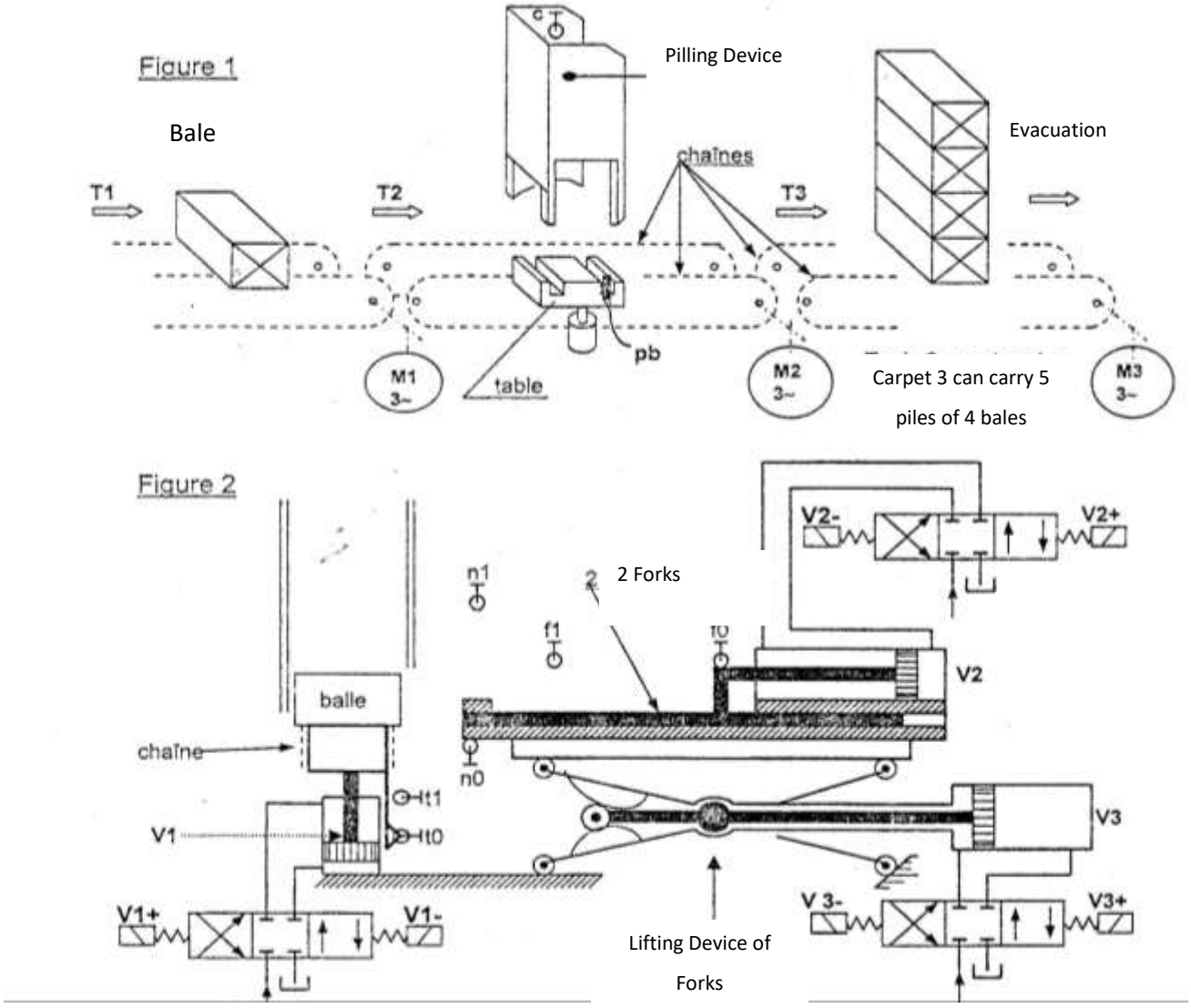

Figure 1 shows the synoptic diagram of a part of an installation of a paper pulp mill factory. It dispatches its product by means of camion or wagon whose loading is done by chariots lifter which carry the pile of bales to the outlet of the carpet T3.

Figure 2 illustrates the stacking of 4 bales and constitutes the installation to be studied

The carpet T1 which operates permanently, brings a bale to carpet 2 about every five minutes.

II- Operation

Initially the robotic piling is filled and any action on the start push button (start cycle) starts the carpet T_2. When a bale arrives under the stacking column (Pb activated), the carpet T2 stops and the table T moves up.

At the end of the upward movement, the forks move out passing through the table slot.

As soon as the forks are completely out (action on f1), the table descends, the forks move out passing through the table slot.

As soon as the forks are completely out (action on f1), the table descends, the forks moves up again to lift the first bale and the carpet T2 is put on to bring the 2^{nd} bale,. As soon as Pb is activated the carpet T2 stops and the table moves up again.

When the table stops moving up, the forks move in when they are completely in (action on f_0) they descend.

At the end of the descending, the cycle of upward movement of the bales resume if the number of bales that arrive on T is less than 4.

If this number is attained, the table descends and then:

- In automatic mode, T2 evacuates the pile of 4 bales and the cycle restarts automatically.
- In mode cycle by cycle, the same operation resume if another order is given to the start cycle.

The incomplete flow chart level 1 shown in fig. 3 illustrates the operation of the system.

III- Technological specifications

The installation is equipped as follows:

- 3 cylinders V1, V2, V3, double effect controlled by hydraulic distributors 3 positions, 4 orifice
- 3 motor M1, M2 and M3 driving the carpets respectively.

a) Cylinders:

Cylinder	Cylinder out	Associated sensor	Cylinder in	Associated sensor
V_1	V_1+	t_1	V_1^-	t_o
V_2	V_2+	f_1.	V_2^-	f_0
V_3	V_3+	n_1	V_3^-	n_o

V1: Movement of the table

V2: Movement of the forks (outward and inward)

V3: Movement of the forks (upward and downward)

b) Electric motors

Designation	Characteristics	Pre actuator
M1	Three-phase induction motor 220/380V. Direct on line	KM1
M2	Three-phase induction star-delta starting	KM2, KM3, KM4, KM5
M3	Three-phase induction rotor resistance starting 3 times	KM6, KM61, KM62

III-2) Control Part

The sensor to, t_1, f_0, f_1 n_o,n_1, c and Pb are limit switches type Telemechanics

f_0: forks in

f_1: forks in

t_o: table up

t_1: table up

n_o: forks below

n_1: forks up

C: Presence of 4 bales on stacking column

Pb: Presence of a bale on the table

S0: Start push bottom for start cycle

S1: Commutator for working mode selection

III.3. Security and Protection

Total isolation of the installation is assured by a 4-poles fused isolator

The motors are each protected by a thermal relay. The control circuit is protected by a fuse

III.4.) Supply network

The supply is three-phase: 380V + N

IV) **Functional Diagram**

The incomplete flowchart level 1 given in fig 3 describes the functioning of the system

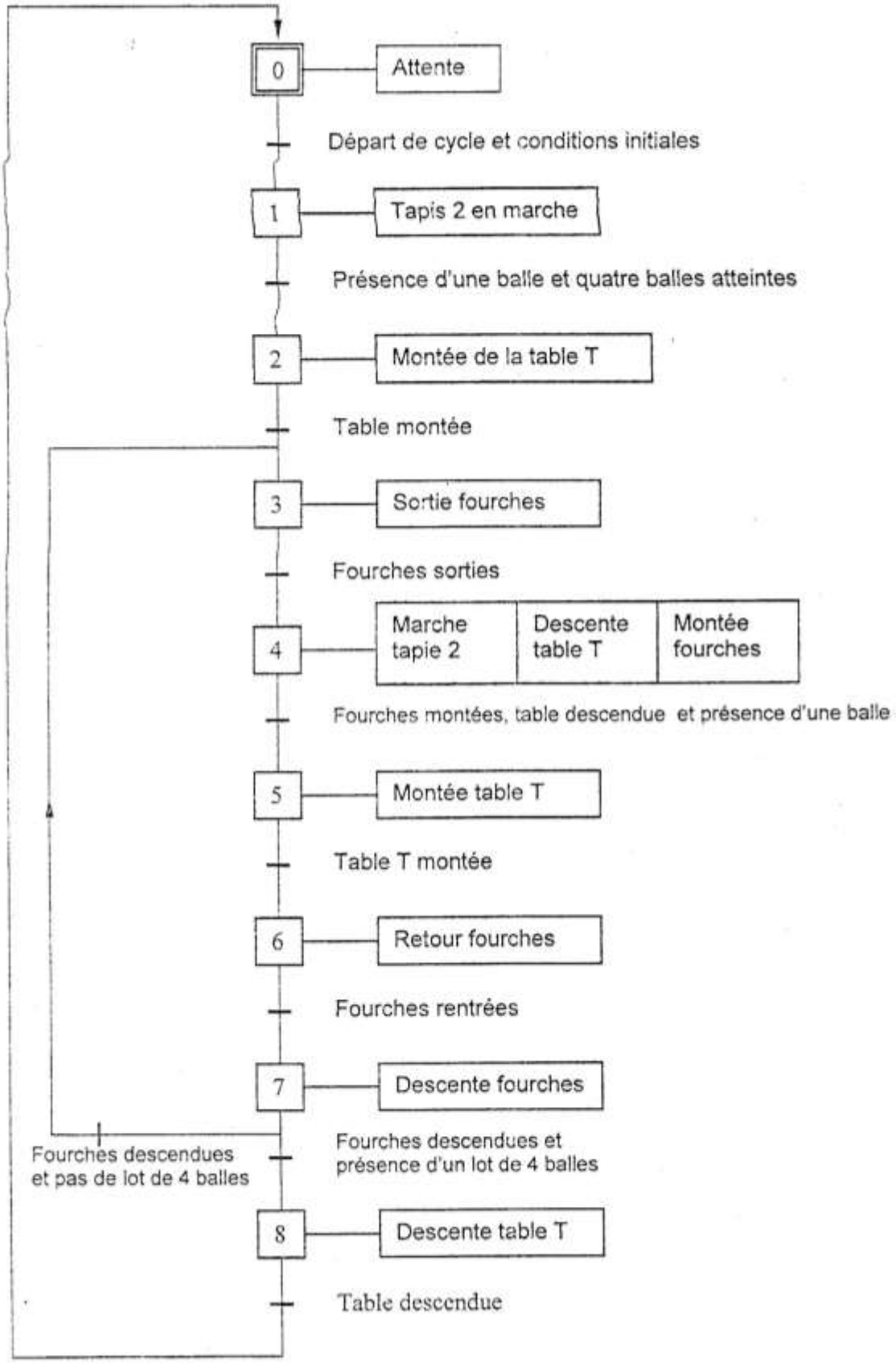
0
Attente
Départ de cycle et conditions initiales
1
Tapis 2 en marche
Présence d'une balle et quatre balles atteintes
2
Montée de la table T
Table montée
3
Sortie fourches
Fourches sorties
4
Marche tapie 2
Descente table T
Montée fourches
Fourches montées, table descendue et présence d'une balle
5
Montée table T
Table T montée
6
Retour fourches
Fourches rentrées
7
Descente fourches
Fourches descendues et présence d'un lot de 4 balles
Fourches descendues et pas de lot de 4 balles
8
Descente table T
Table descendue

Figure 3

V) Work required

1. Using the incomplete GRAFCET level 1, establish the GRAFCET level 2 that corresponds to the operation of the system
   5mks
2. Establish the equation of activation and deactivation of the GRAFCET level 2 3mks
3. How would you connect the windings of motor M1 to the supply? Draw the power diagrams of the motors M1 and M3 3.5 mks
4. Write the program of the automation using any of the following languages
   - Ts x 21, Tsx 27, Ts x 47: Telemechanique
   - PB 100. Merlin Gerin
   - SLC 100 AB D'Allen Bradley

MARKING SCHEME

a) Addressing the inputs / output 1.5mk
b) Programming steps 4mks
c) Programming of the outputs 2.5mks