Cairo University
Faculty of Engineering
Mech. Power Department

ACC Virtual Labs
Automatic Control Circuits & Virtual Labs For Mechanical Power Systems

دبلوم تطبيقات التحكم الأوتوماتيكى فى نظم القوى الميكانيكية

MEP 599 Diploma Design Project – Summer of Year 2014

Using PLC system to operate and Control a Low Capacity Fire Tube Boiler Type

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Abstract:

The objective of this project is to examine various conventional sub-systems used to operate and safely control a low capacity fire tube boiler. Our aim is to investigate the use of PLC system to replace these essential mechanical parts. All required safety and control inputs & outputs for the PLC are identified. The programming LAD diagram is also made and tested. A simulator software is used to run this LAD diagram to show that the sequence of Boiler operation and the safety conditions are satisfied using PLC control system.

Boiler Installation Requirements

- ❑*Boiler house Pipe Work*
- ❑ *Feed Water Requirements*
- ❑ *Blow down requirements*
- ❑ *Clean Air Act Requirements for Exhaust Gases from Chimneys.*

Automatic Control Systems on the Boiler for Stable & safe Operation:

- *Combustion Control Appliances*
- *Feed-Water& Water level Control*
- *Blow down Control*

Operation Sequence Requirements:

- ✓*Permanent adjustments*
- ✓ *Regular Adjustments*
- ✓ *Automatic sequence*
- ✓*System Interruptions*

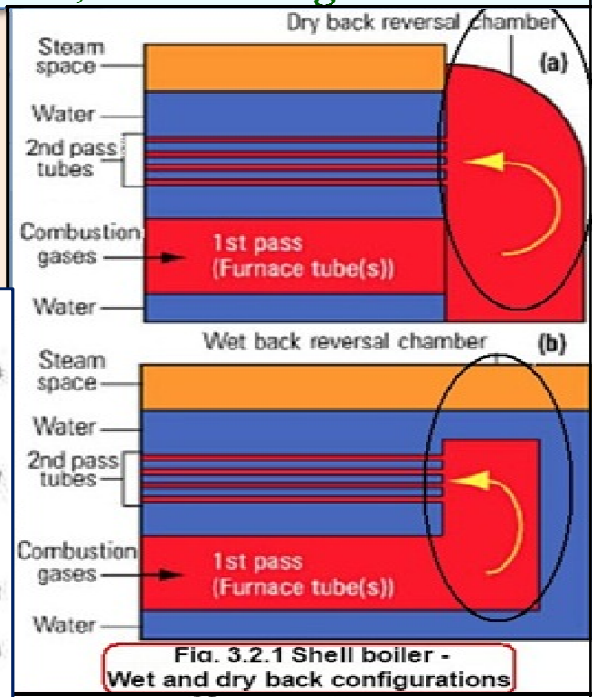
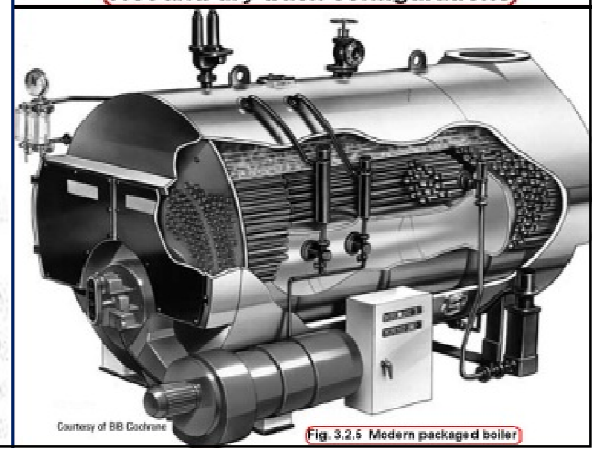
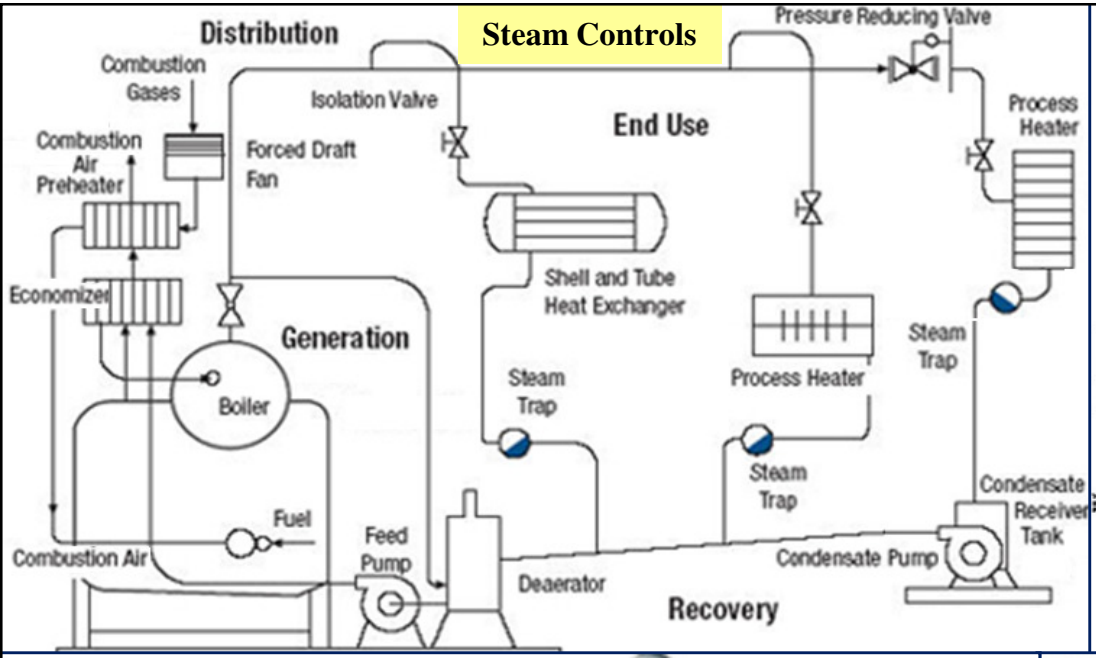


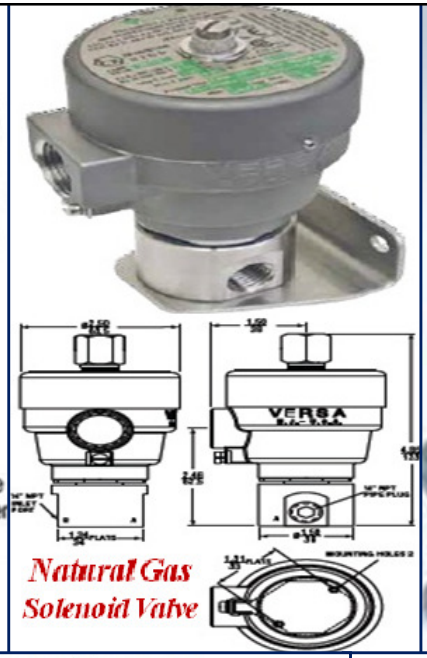
Fig. 3.2.1 Shell boiler - Wet and dry back configurations



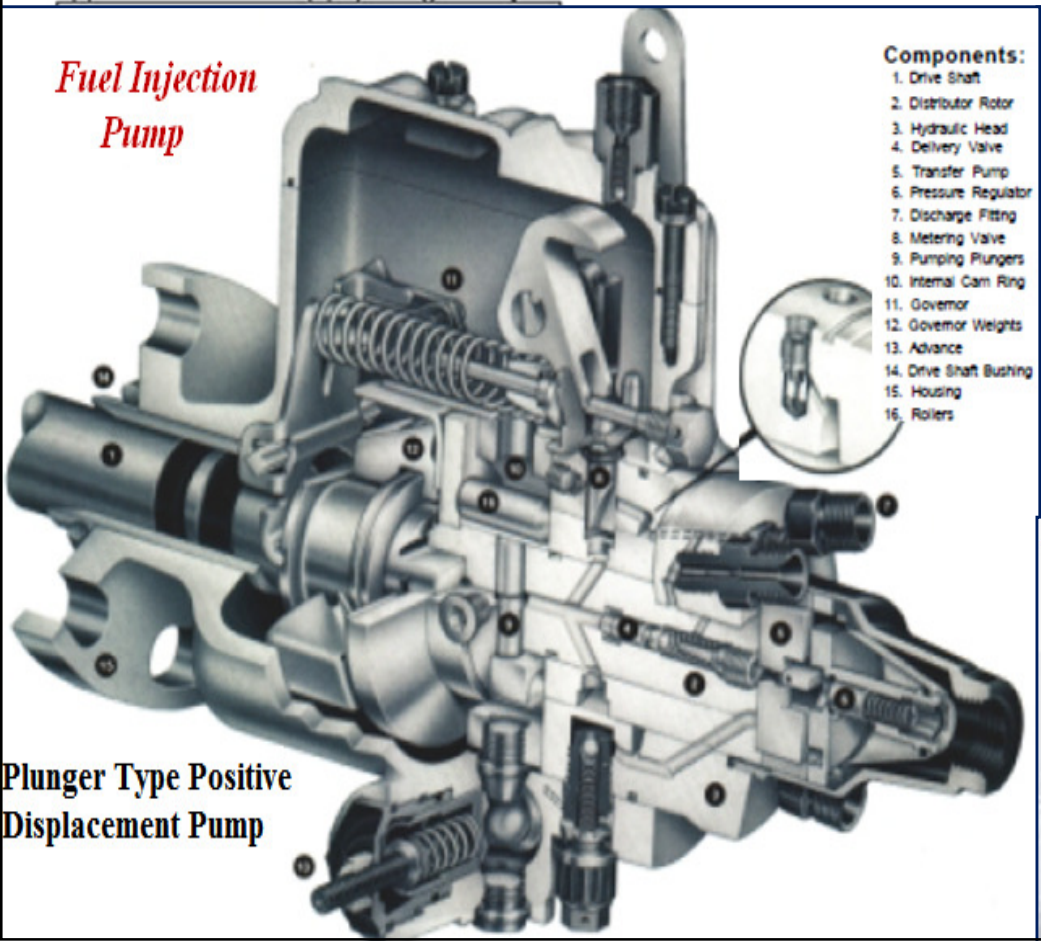
Courtesy of BB Cochrane

Fig. 3.2.5 Modern packaged boiler

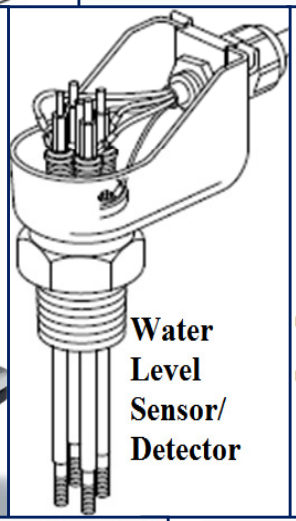

Steam Controls
Distribution
Combustion Gases
Isolation Valve
Pressure Reducing Valve
End Use
Process Heater
Combustion Air Preheater
Forced Draft Fan
Economizer
Shell and Tube Heat Exchanger
Generation
Steam Trap
Process Heater
Steam Trap
Boiler
Steam Trap
Condensate Receiver Tank
Fuel
Feed Pump
Combustion Air
Condensate Pump
Deaerator
Recovery

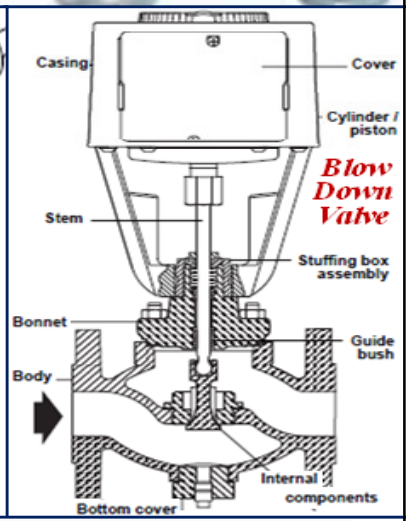

VERSA
Natural Gas Solenoid Valve

Pressure relief valve
"safety valve

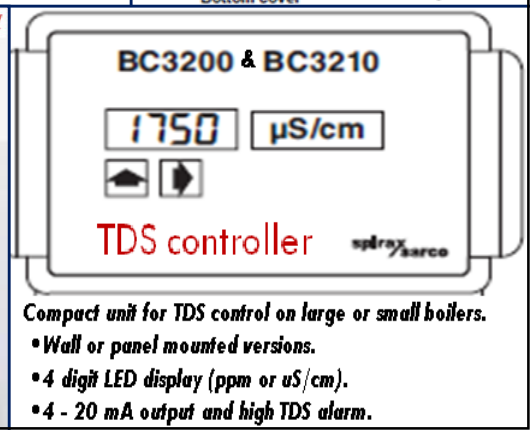

Fuel Injection Pump
Components:
1. Drive Shaft
2. Distributor Rotor
3. Hydraulic Head
4. Delivery Valve
5. Transfer Pump
6. Pressure Regulator
7. Discharge Fitting
8. Metering Valve
9. Pumping Plungers
10. Internal Cam Ring
11. Governor
12. Governor Weights
13. Advance
14. Drive Shaft Bushing
15. Housing
16. Rollers
Plunger Type Positive Displacement Pump

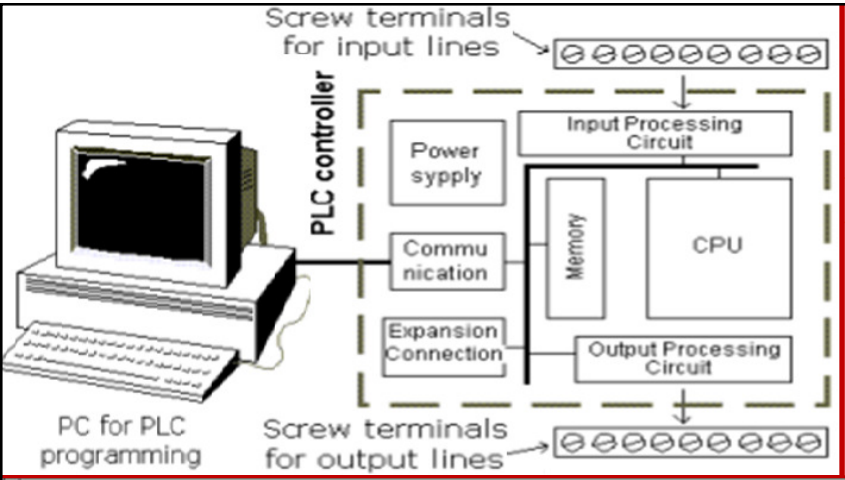
BCP type High&low pressure limiters as well as pressure controllers
Media: Steam, water & air
Pressure Switch
Danfoss


Water Level Sensor/ Detector


Casing
Cover
Cylinder / piston
Blow Down Valve
Stem
Stuffing box assembly
Bonnet
Guide bush
Body
Internal components
Bottom cover

Actuator For Air Volume Control


BC3200 & BC3210
1750
µS/cm
TDS controller
spirax sarco
Compact unit for TDS control on large or small boilers.
•Wall or panel mounted versions.
•4 digit LED display (ppm or uS/cm).
•4 - 20 mA output and high TDS alarm.



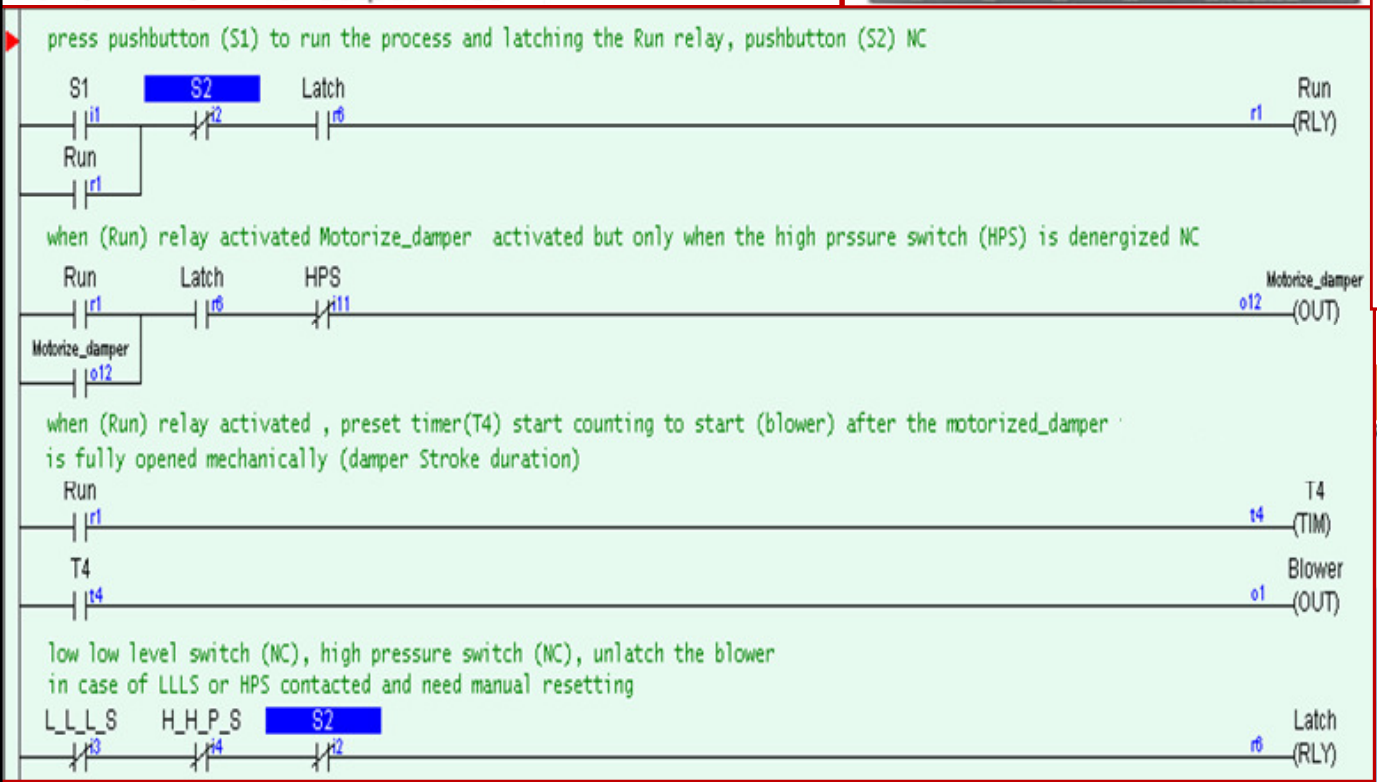
PLC EM& HMI

PLC Simulator

i-TRiLOGI Client/Server Architecture

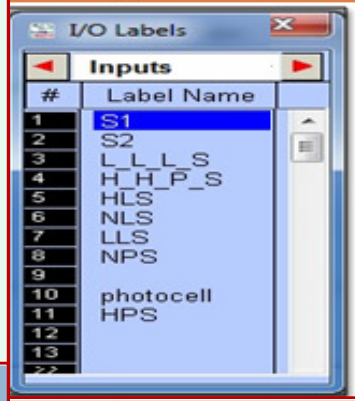
➢ *Inputs*

Name	Abbreviation	Address	Function
pushbutton	S1	I0.1	Start the program
pushbutton	S2	I0.2	Stop the program
Low low level switch	L_L_L_S	I0.3	Send signal =1 at low low level for water
High high pressure switch	H_H_P_S	I0.4	Send signal=1 at boiler pressure reach preset value
High level switch	HLS	I0.5	Send signal =1 at high level for water
Nominal level switch	NLS	I0.6	Send signal =1 at nominal level for water
Low level switch	LLS	I0.7	Send signal =1 at low level for water
Nominal pressure switch	NPS	I0.8	Send signal=1 at boiler pressure reach preset value
Photocell	Photocell	I0.9	Send signal=1 when flame is detected
High pressure switch	HPS	I0.11	Send signal=1 at boiler pressure reach preset value



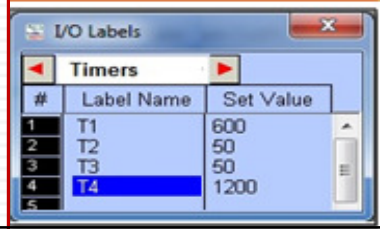
I/O Table

Inputs



Outputs

Timers



Relays

Summary

- Control systems general overview
- Boiler Design & Operation Requirements
- Sequence Of Operation
- Technical selection for Inputs and Outputs "Controllers"
- PLC Sequence of Operation
- PLC hardware Selection
- PLC Program "LAD" Design