RETROFIT OF SHIPS MAIN ENGINE REMOTE CONTROL SYSTEMS

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Abstract: *The current paper will present the methods, ways and concrete schemes for retrofit of ships main engine remote control (RC) systems. The drawing solutions from realized projects will be discussed for different engines. Analysis for the projects is done. Modern remote control systems of ships diesel engines are mentioned in this paper.*
KEY WORDS: *SHIPS ENGINES, CONTROL, SYSTEMS RETROFIT AND UPGRADE*

I.Introduction

Nowadays, electronic equipment development in ship industry created a good conditions for increasing of accuracy and reliability of RC system for main engines (ME). The most of new-built vessels are equipped with electronic RC system. But into the world ocean are sailing and older ships with earlier versions of RC operated with mechanical-pneumatic manner. Many ship owners want to increase reliability and working hours of their units but, how it looks like, the spare parts are missing already, so only one solution is possible – renewing of RC system. At the moment a few projects are done for non-reversible engines and one for reversible slow speed engine MAN B&W type. All new systems are approved by Register's classification inspection with attached documentation.

II. Projecting and creating of new RC systems:

After job confirmation latter is received the work plan is accomplished:
- Familiarization with engine type, all operating curves, work modes, limits and safety algorithm.
- Projecting of control algorithm, including sequence of RUN, STOP, REVERSE(if any) modes, clutch operation and propeller pitch, safety and limits programs.
- From the algorithm done the new elements are extracted like type and numbers.
- Delivery, fit on place and sea trails.
- New drawings and papers are prepared.
- Giving over with ship crew and the Register.

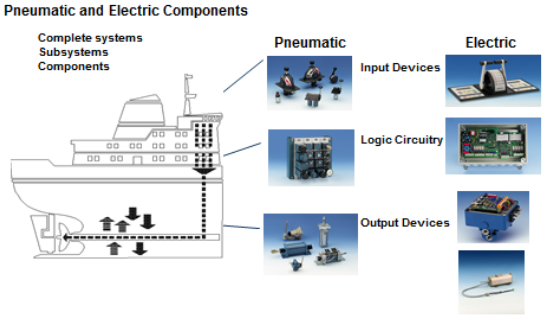

Fig.1

Fig.1 shows the devices which are replaced each other. Speed setting comes through analogue signal 4-20mA, instead of governor with air control pressure 0,5-4,5 bar. The logic algorithm is programmed into controller, instead of pneumatic box with 40-60 valves. The final units are transmitters current/pressure or electro-motors. They replaced pneumo- and hydrocylinders and valves also. At the projects done ME's are mostly SKL, MVM and Deutz type. The mode change is provided by engine rpm and the propeller is with fixed pitch. Engine reversing become by means of electrically controlled clutch (Fig.2.) This is an example for pneumatically system consisted of distributors, valves, air service station and control handle connected with air reducing valve for speed setting. All elements required periodical maintenance and repair kit replacing from manufacturer made. Unfortunately for mostly old vessels the spare parts price is too high or the manufacturing is already closed.

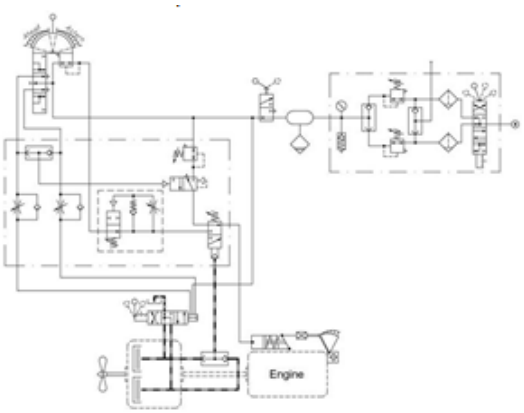

Fig.2

The scheme used for control of hydraulic distributor on reverse clutch and mechanical control of ME speed setting is shown on Fig.3.

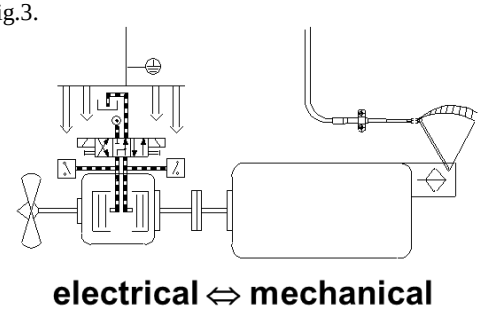

Fig.3

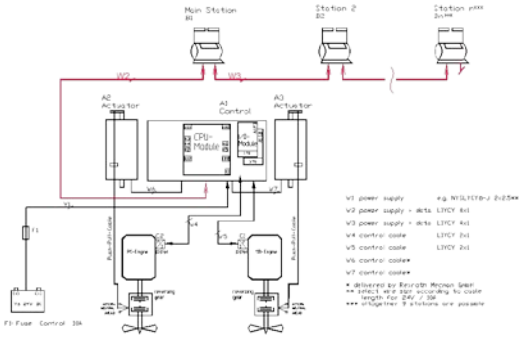

Fig.4

As presented (Fig.4) three control stations for ME are connected with CAN bus in between and all are linked with main controller which calculated output signals to rpm governor and reverse clutch. In this case ship power plant contains two ME's operating with two fixed pitch propellers.
Main functions realized with this solution:
- Speed setting and clutch control.
- Propeller pitch control(option).
- Modes: normal, reverse and emergency reverse.
- Monitoring and safety systems.

Some of projects are made with original mounted sensors and safety switches(like oil pressure switch) and the rest projects used only fully replaced measuring and safety systems.

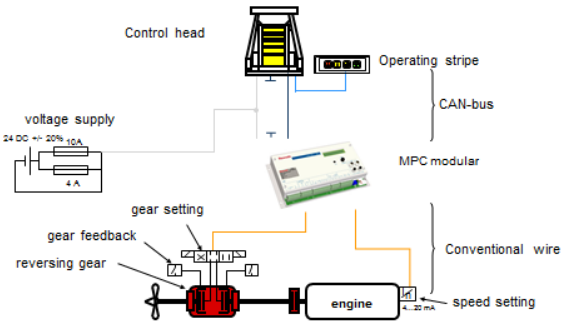

Fig.5

The principal diagram of ME RC system is shown on Fig.5. Here is presented a system with one control station and a panel with the following signals emergency RUN, STOP, and LIMITS CANCEL. Independent supply is ensured by batteries 24 VDC which gives reliable control and alarms.

Fig.6

Fig.7

The main components of river ship RC systems are displayed. On Fig.6 monitoring system includes three ME's equipped with separate control and programmable module.
Especially for these purposes the mimic alarm station is developed. It is adapted by types and numbers of alarms depending of engine model and original curves. The "freeze" function is very important and suitable during engine shut down since keeping the "picture" from the condition before stop mode.

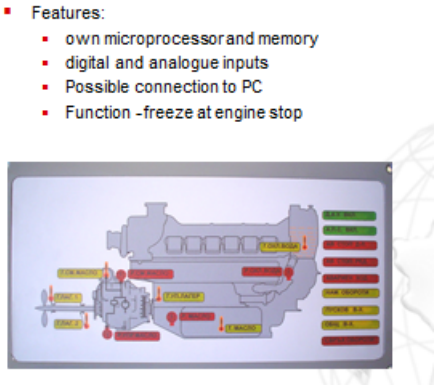

Fig.8

The list with base functional CPU parameters is applied below. The adjustments depend from engine type, power plant configuration and operational modes.

Parameter representation of the I/O modules

Parameter			values			
No	function	menu display	default	min	max	meaning
2	version of the table of parameters	-		1)	1)	
3	start-up state of relay K2	-	0	0	2	0: relay is turned off
4	start-up state of relay K3	-	0	0	2	1: relay is turned on
5	start-up state of relay K4	-	0	0	2	2: relay remains unchanged
6	configuration of the analog input 1 (board 346 067 716 2, clamp)	**Input1**	0	0	4	0: current 4-20mA (R_{in} 200Ω) 1: current 0-20mA (R_{in} 200Ω) 2: voltage 2-10V (R_{in} 10kΩ) 3: voltage 0-10V (R_{in} 10kΩ) 4: resistor (0-10V) (R_{in} 2,5MΩ)
7	configuration of the analog input 2 (board 346 067 716 2, clamp)	**Input2**	0	0	4	
8	configuration of the analog input 3 (board 346 067 716 2, clamp)	**Input3**	0	0	4	
9	function of the voltage output (board 346 067 716 2, clamp 57)	-	0	0	1	0: 10V reference output 1: 0-10V (adjustable via PDO)
10	configuration of the analog output 1 (motherboard, clamp 16/17)	-	0	0	1	0: 4-20mA 1: 0-20mA
11	initialization value of the analog output 1	-	0	0	32760	0: 0mA 32760: 20mA
12	configuration of the analog output 2 (board 346 067 716 2, clamp 59/60)	-	0	0	1	0: 4-20mA 1: 0-20mA
13	initialization value of the analog output 2	-	0	0	32760	0: 0mA 32760: 20mA
14	Life time factor	**LFT**	2	0	255	LFT * GT = triggering time for Guarding error (at LFT = 0 or GT = 0 guarding is turned off)
15	Guarding time	**GT**	1000	0	65535	time is displayed in ms
16	Basis-Id for Guarding	-	0x700[2)]	0x6e0	0x7de	the sum of module Id and Basis Id for Guarding must be acc. to CANopen between 0x6e1 and 0x7df
17	module-Id of the I/O-nodes	**Id**	5	1	100	
18	selection of the CANopen Boot-up	**qBoot**	0	0	1	0: Boot-up after CANopen. The node assumes after power-on at first the state *preoperational* and only after a NMT-Message from the Master has been received, it moves to the state *operational* 1: as opposed to CANopen the node moves directly to the state *operational* (is only used if operating older master nodes) Note: only in the state *operational* the inputs and outputs are available via PDOs
19	display of the parameters and errors in the menu	**symbols**	1	0	1	0: numeric 1: symbolic

Fig.9

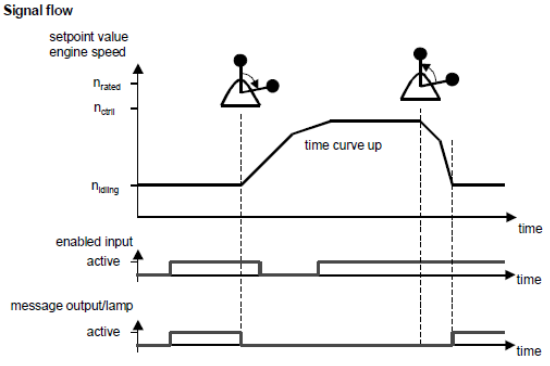

Fig.10

Fig.10 shows speed setting program curve for one of the projects for SKL engine.

IV. Results analysis

The key results from new systems introducing are higher reliability, higher accuracy with speed setting and easier readjusting of parameters according staff requirements. At one of the vessels the old RC system is saved and new one works separately from it. Since three years the original one have used never. Also good scope is a

light maintenance which no needs yearly based prophylactic nor an air compressors with air service system.

V. Conclusion

ME RC system retrofit is a complicated and accountable engineering task. The discussed projects are made thanks to:

- Good team work of all involved persons.
- Trusty equipment and software approved with Register's admissions.
- Field experience and skills with ship automation systems.

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