ARROW ENGINE COMPANY

AUTOSTART NS-2

PARTS, OPERATION & MAINTENANCE

AUTOSTARTNS2-POM-S-SEP17

A Tradition of Excellence Since 1955

ARROW™ ENGINE COMPANY

Arrow Engine Company was founded in 1955 as Arrow Specialty Company by Jeff Davis in Tulsa, Oklahoma, beginning a tradition of providing premium service and exceptional products to the oil & gas industry, as well as other industrial markets throughout the world. Arrow is a market-leading provider of natural gas powered engines and parts, as well as gas compressors, gas production equipment, meter runs, engine electronics and chemical pumps. Today, Arrow continues its tradition of focusing on producing the most reliable equipment, parts and extraordinary customer service in the industry.

Arrow is a part of IES Infrastructure, which operates as one of four divisions under IES Holdings, Inc. comprised of over 8,000 employees nationwide. IES Infrastructure provides electrical and mechanical apparatus services, custom steel fabrication, and custom power solutions including generator enclosures and bus systems to customers both in the United States and abroad.

AUTOSTART NS-2

PARTS, OPERATION & MAINTENANCE MANUAL

AUTOSTART-POM-C-SEP17

2301 East Independence

Tulsa, Oklahoma 74110

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1.0 Features

1.1 SUMMARY

The Autostart-NS-2 for all Arrow engines is a simple, programmable system that allows for different cycles each day of the week as well as continuous monitoring of critical engine operating parameters and automatic shutdown. This system features a built-in tachometer, hour meter and battery voltage meter. The automation can be set to real time, interval timing, manual mode or remote start, giving you everything you need to easily automate and monitor your oil field operations.

1.2 ENVIRONMENTAL CONSTRAINTS

1. Height above sea level: ≤ 3,280′ (1000 m)
2. Relative humidity: ≤95%
3. Environment temperature: 23-104°F (-5 ~40°C)
4. Avoid explosive and dangerous gases, avoid dusty areas.

1.3 OPERATION FEATURES

1. Automatic ON/OFF cycle timing (independently adjustable).
2. Automatic start-up sequence complete with adjustable warm-up timing.
3. Display any start-up faults and alarm if the engine fails to start.
4. Continuous monitoring of critical operating parameters and automatic unit alarm when an out-of-limits condition is detected.
5. Low oil pressure alarm.
6. Engine over crank alarm.
7. Engine over speed alarm.
8. Engine loss speed alarm.
9. Engine under speed alarm.
10. High JW water temp alarm.
11. Monitor oil circuit integrity. This insures that the oil pressure switch is closed (signaling low oil pressure) prior to starting the engine.
12. Automatic ON/OFF cycle time may be set for up to six attempts.
13. Audible alarm prior to and during engine start up.
14. Start and stop the engine at desired times.
15. Added capacity for additional connections on terminal strip.
16. Three position switch keys for automatic/stop or manual operation.
17. 12-volt start relay (mounted in box).
18. Circuit breaker to protect clutch control circuit

1.4 PANEL FEATURES

Shutdown with first out annunciation (stops the unit when a preset abnormal condition exists and indicates the cause of the shutdown).

Switches, Push buttons, Indication lights Circuit protection:

- Panel Power ON/OFF Switch
- Panel ESD Button (mounted on right side). Emergency shutdown button locally mounted on side of the enclosure which will trigger an immediate shutdown in the Autostart and cause an immediate shutdown of the engine.
- Manual Load Switch
- Warning Buzzer/Light
- 15 amp circuit breaker
- RESET (On controller)
- AUTO (On controller)
- START (On controller)
- FAILURE Light (On controller)
- ALARM Light (On controller)
- REMOTE Light (On controller)
- Sensors are normally open during operation of the machinery. Closing of the contact to ground signifies a device failure and should activate a unit shutdown.
- Wiring Harness provided.
- Real time clock. Maintains time/date when power is off.

Displayed Data:

Main Screen 1

- Current speed in RPM
- Current/last run time counter. (Accumulates when engine is running. Resets on next start.)
- Total run time/hour meter (Accumulates when engine running, cannot be reset.)
- Battery voltage

Main Screen 2

- Mode status
- Next Scheduled start time
- Shutdown/alarm status

Other

- Input/output status
- Set parameters
- Shutdown record

2.0 Installation

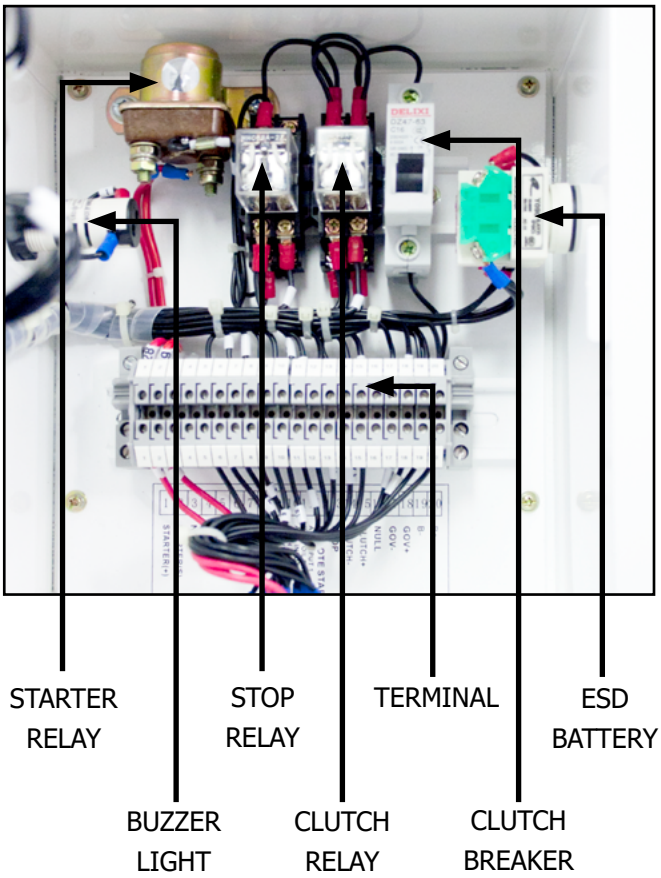
2.1 INSTALLATION

Perform the follow tasks before using the controller.

1. Clean up components as needed.
2. Check the press-keys to assure they are flexible and make sure the contacts are snug.
3. Controller should be mounted off engine skid on 2” pipe or suitable metal structure.
4. Disconnect the battery before doing any wiring, and make sure your Autostart is installed no more than 20’ from your engine.
5. Connect the controller to engine according to the wiring diagram.

AutoStart NS-2 Controller

AutoStart NS-2 Internal Layout



3.0 Maintenance

3.1 MAINTENANCE

1. Keep the Autostart clean, protecting the unit from dirt and water exposure.
2. Check the connections inside and outside the unit.
3. Check the DC battery voltage regularly. If the voltage is lower than 10V, the battery will need to be recharged. Make sure not to reverse the connection of the positive pole and the negative pole when reconnecting the battery to the Autostart.
4. Read the Operations Manual and be familiar with the engine operation and usage.
5. Arrow suggests that the controller be checked by a technician annually. Untrained personnel should avoid maintenance of Controller. If there is a fault that cannot be resolved, please call Arrow Engine at 1-(800)331-3662. Please provide serial number, the manufacture date and the type of engine controlled.

4.0 Operation

4.1 BASIC OPERATING INSTRUCTIONS

Operation Buttons

Button	Function
	Press this button and the green LED will light up indicating that the controller has gone into "start" state. The engine will start and run in MANUAL MODE.
	Press this button and yellow LED will light up indicating that the controller is in "AUTO START" mode. If the controller receives the "REMOTE START" signal (switch closed), the engine will be started and run until the "REMOTE START" signal is removed (switch open). If timed start is active, the engine will start and stop as it has been programmed to do.
	Press the button and red LED will light up indicating that the controller is in "STOP/ RESET" mode. The controller will activate the "ENGINE COOLDOWN". de-energize the clutch, slow the engine to idle, activate cool down timer and then stop the engine after the timer expires. During "ENGINE COOLDOWN", the indicator will flash and will stay on after the engine stops.

SYSTEM MENU KEYS

Pressing the "SET" key for 10 seconds takes you to the parameter setting menu. See the chart below for how to use the flexible buttons to navigate and enter data in the system menu.

Button Name	Arrow Points...	Function
SET	→	Parameter setting / enter next menu / confirm revision
RESET	←	Exit / back to the previous menu
AUTO	↑	Page up the menu / increase value
START	↓	Page down the menu / decrease value

STATE INDICATOR LIGHT

Light On	This is what it is telling you...
	Indicates engine failure, protected stop, or start failure. The fault content will display on the LCD screen, e.g.: start failure, over speed low oil pressure, etc. This fault will lock the system. The operator must press the "RESET" key before attempting to restart the engine.
	Indicates engine warning information, though the engine will continue operating as normal. See the LCD screen for detailed info, such as low battery, etc. The controller can display multiple alarms, as needed.
	Indicates "REMOTE START" input status. This signal can come from local switch or remote controller.

4.2 AREA CLASSIFICATION OF CONTROLLER

Non-hazardous area.

4.3 POWER REQUIREMENTS

10.5 to 13.8 VDC power supplied to panel by customer.

4.4 ENCLOSURE

- Designed to NEMA 4 standards to protect against weather and washing.
- Hinged front door with front panel items mounting through door. Panel is front access only.
- Electrical openings for engine connections are provided on the bottom of the panel.
- Painted enclosure – White
- Dimensions 11” x 10” x 6” (H x W x D)

4.5 CONTROLLER INPUTS & OUTPUTS

Discrete Input TO Controller:

- ESD
- REMOTE START
- LOW ENGINE OIL PRESSURE (Input 1)
- HIGH ENGINE JW TEMPERATURE (Input 2)
- ENGINE OIL PRESSURE EXCESSIVE (Input 3)(Jumper if not available)
- AUXILIARY SHUTDOWN (Input 4)

Discrete Output FROM Controller

- ELECTRIC STARTER (10 amp relay)
- IDLE/RATED ENGINE SPEED CONTROL (5 amp contact)
- STOP (6 amp relay)
- CLUTCH (6 amp relay)

High Speed Input

- ENGINE SPEED (MAG PICK-UP) 5-120VRMS

4.6 STARTING UNIT

Prior to start-up, the operator must make certain all equipment is in acceptable condition as described in instruction and operation manuals, and per local maintenance and safety procedures.

Modes of operation

There are three modes of operation: **Local Manual Start**, **Local Automatic Start**, and **Remote Start**. In any mode, the controller will attempt to start and restart the unit according to the system start settings once the "START" button is pressed or the REMOTE START signal is received.

Local Manual Start

- The operator presses the "START" button on the controller to initiate the start process.
- Manual start will bypass all timed start settings. The operator will be responsible for starting and stopping the engine. All engine protection devices will remain active
- Do not press mechanical reset on oil pressure gauge.

Local Automatic Start

- In Automatic Mode the controller will initiate the start and stop sequence according to the timed start settings (see Timing Start Set table pg 11).
- Operator turns on local automatic mode by pressing the "Auto" button on the controller. The controller will display that the controller is in "AUTO MODE".
- Prior to start up, the operator will need to enter the desired Start-Stop cycles. The operator can select up to six (6) controlled start-stop cycles per 24 hr period.

Remote Start

- With the controller in "AUTO MODE" the start sequence will start when the remote start contacts are closed to the controller. The controller will initiate the start sequence automatically. When the REMOTE START signal opens the controller will initiate the stop sequence.

ENGINE START SEQUENCE

1. Turn power switch to the "On" position. This powers up the controller's components. Shutdowns are armed.
2. If all shutdowns are clear, the display state will read "STOP/OFF STATUS" to indicate that the panel is able to start.
3. When the START sequence is initiated, the controller will sound the start warning buzzer. The buzzer will remain on for a designated time (operator configurable). After the timer expires and the low engine oil pressure switch is confirmed, the controller will power the crank signal (10 amp interposing relay) and will send a signal to the starter solenoid to start the engine.
4. The engine start duration timer will begin timing. The display will read "ENG. START: 00"
5. When the start duration timer expires, the fuel valve is opened and the STOP relay is powered to unground the ignition. The display will read "PRE_START: 000". After this delay with the start signal present the crank cycle will begin. The display will read "CRANK TIME: 000 1".

6. When the engine speed passes the trip speed RPM set point, the engine is considered to be running, and the crank output will be disengaged. If the engine does not start before the engine start duration timer expires, the controller will initiate a RESTART delay timer. When the timer expires the controller will attempt another start cycle. If the engine doesn't start in the selected amount of CRANK ATTEMPTS the controller will shutdown the engine on over crank.
7. When the RPM raises above the acceleration limit RPM setting, the engine will be seen as "running." Note: Engines without governor control will go directly to rated speed.
8. After the run signal is received, the internal run hour meter will start accumulating.
9. The controller will display "ENGINE IDLE RUN". The warm-up timer will be displayed and start to countdown. Display will read "Warming Up: 000".
10. When the proper engine oil pressure (via switch) is met, the controller will close the signal to the engine governor to take the engine to the rated speed. The controller will display "ENGINE RATED RUN".
11. If at any time the engine drops below the under-speed set point, the controller will shutdown the engine.

4.7 UNIT OPERATION

Load Sequence

Once the engine is running at its rated RPM the controller will start a WARM-UP timer. In the AUTOMATIC MODE, when the WARM-UP timer has expired the controller will energize the CLUTCH output. The display will read "ENGINE LOAD RUN".

In Manual Start Mode after the WARM-UP timer has expired, the operator will toggle the MANUAL LOAD switch on the controller to the ON position to activate the clutch and load the unit. Display will read "ENGINE LOAD RUN".

Unload Sequence

In AUTOMATIC MODE the Controller will disengage the clutch to unload the unit and start cool down. The display will read "COOLING DOWN: 000". After the cool down timer has expired the controller will open the signal to the engine governor to take the engine to idle speed. The display will read "ENGINE IDLE RUN", and the idle stop timer will start. The display will read "IDLE STOP: 000". After the idle stop timer expires the controller will power the stop relay to ground the ignition and stop the engine.

In Manual Start Mode the operator will have the ability to disengage the clutch without stopping the engine by toggling the MANUAL LOAD switch on the controller to the "OFF" position to disengage the clutch and unload the unit.

4.8 SHUTDOWN

Normal Stop Sequence

This operation to be followed independent of mode of operation the controller is in.

1. Push the "RESET" Button on CONTROLLER
2. The CLUTCH signal will power down. A cool down timer will start.
3. After the cool down timer has expired, the ignition delay will begin timing.
4. Once the ignition delay expires, the ignition output will be energized to disable the ignition. The output will remain energized for an adjustable time.
5. The display status will read "STOP/OFF STATUS" and await the next start sequence.

ESD and Fault Shutdowns

- If a shutdown condition occurs, all outputs will power down and immediately stop the unit.
- The display state will detail the cause of the shutdown in a first out manner.

4.9 SETTING OPERATING PARAMETERS

Date and Time

DESCRIPTION	DEFAULTS
Year-Month-Date/Week	00-00-00/00
24 Hour : Minute : Seconds	00:00:00

ALARM LIMIT SET

DESCRIPTION	C Series	K6	VR Series
Acceleration Limit	0100	0050	0050
Deceleration Limit	0400	0800	0800
Reserved	0000	0000	0000
High Speed Alarm	0900	1000	1800
Low Speed Alarm	0200	0200	0750
Over Speed	1000	1000	2000
Under Speed	0350	0400	0700
High Coolant Temp	-	-	-
High Fuel Level	-	-	-
Low Fuel Level	-	-	-
Low Battery Level	0085	0085	0085
Low Charger	0080	0080	0080
Low Oil Pressure	-	-	-

MEASURE REGULATE – MEASUREMENTS CALIBRATION

DESCRIPTION	C Series	K6	VR Series
Battery Voltage	142	142	142
Charger Voltage	134	134	134
Coolant Temp	-	-	-
Oil Pressure	-	-	-
Fuel Level	-	-	-

DELAY TIME SET

DESCRIPTION	C Series	K6	VR Series
Cool down	02	20	20
Engine Start	0	03	0
Crank Interval Delay	30	15	15
Crank Time	20	08	08
Bypass Time	02	25	25
Energize To Stop	03	0	0
Pre-Start Delay	05	05	05
Idle Start Delay	10	05	30
Idle Stop Delay	10	15	30
Acceleration Time	0	0	0
Aux. Input 1 Delay	02	05	05
Aux. Input 2 Delay	0	05	05
Aux. Input 3 Delay	02	02	02
Aux. Input 4 Delay	0	0	00
Charger Fail Delay	30	30	30
Low Battery Delay	20	20	20
Retransformation Delay	02	05	02
Loss Speed Delay	03	05	01
Over Speed Delay	05	05	05
Under Speed Delay	10	10	10
Warm Up Delay	10	10	10
Deceleration Delay	0	0	0

SYSTEM SET – SYSTEM PARAMETER SETTINGS

DESCRIPTION	C Series	K6	VR Series
Trip Speed	200	300	300
Gear Teeth	200	125	115/121*
Password	0000	0000	0000
Address	120	120	120
Analog Set	01	01	01
Output 1 Set	01	01	01
Output 2 Set	011	011	011
Output 3 Set	002	002	002
Output 4 Set	004	004	004
Input 1 Set	01	01	01
Input 2 Set	005	005	005
Input 3 Set	0	0	0
Input 4 Set	011	011	011
Crank Method	0	0	0
Display Mode	0	0	0
Language	1	1	1
LCD Mode	0	0	0
Speed Source	1	1	1

* 115 for A42 and A62; 121 for A54.

TIMING START SET

DESCRIPTION	Time Range	DEFAULTS	FIELD SET
DATE	Year-Month-Date/Week	00-00-00/00	00-00-00/00
T-1	Begin Time 24 Hour: Minute	00:00-00:00	08:00-9:30
T-2		00:00-00:00	9:35-11:30
T-3	End-Time 24 Hour: Minute	00:00-00:00	12:30-16:58
T-4		00:00-00:00	17:35-18:30
T-5		00:00-00:00	19:35-20:30
T-6	23.59 - 23.59	00:00-00:00	21:35-22:30

Example: The date of timing start is set to 00-00/00. Time is set to 09:00-13:00 and 14:00-18:00. This means that every day of every week of every month, the engine will start at 9:00 and stop at 13:00, then start again at 14:00, stopping at 18:00. Six time intervals can be set on every day - please set to ”0” for any unused time intervals.

5.0 Replacement Parts and BOM

5.1 PARTS

AUTOSTART-NS-2-ASSY

AUTOSTART-NS-2-24V-KIT

AUTOSTART-NS-2-ASSY-24V

AUTOSTART-NS-2-ASSY

DESCRIPTION	Arrow Part No.
AUTOSTART - New style - Version 2	AUTOSTART-NS-2
RESISTANCE SPARK PLUG WIRE/AUTOSTART	330-20-225-R
AUTOSTART NS-2 WIRE HARNESS	AUTOSTART-NS-2-HARNESS
Bracket Pickup for Genset	5430-929-B
Mag Pickup	MP-3298
AUTOSTART-NS-2 SERIAL NUMBER PLATE	AUTOSTART-NS-2-SERIAL NUMBER
AUTOSTART-NS-2 Face Sticker	AUTOSTART-NS-2-FACESTICKER

AUTOSTART-NS-2-24V-KIT

DESCRIPTION	Arrow Part No.
AUTOSTART RELAY 24V	AS-NS2-RELAY-24V
AUTOSTART - STARTER SOLENOID 24V	AS-NS2-STARTSO-24V
AUTOSTART - BUZZER WITH LIGHT 24V	AS-NS2-BUZZLIT-24V

AUTOSTART-NS-2-ASSY-24V

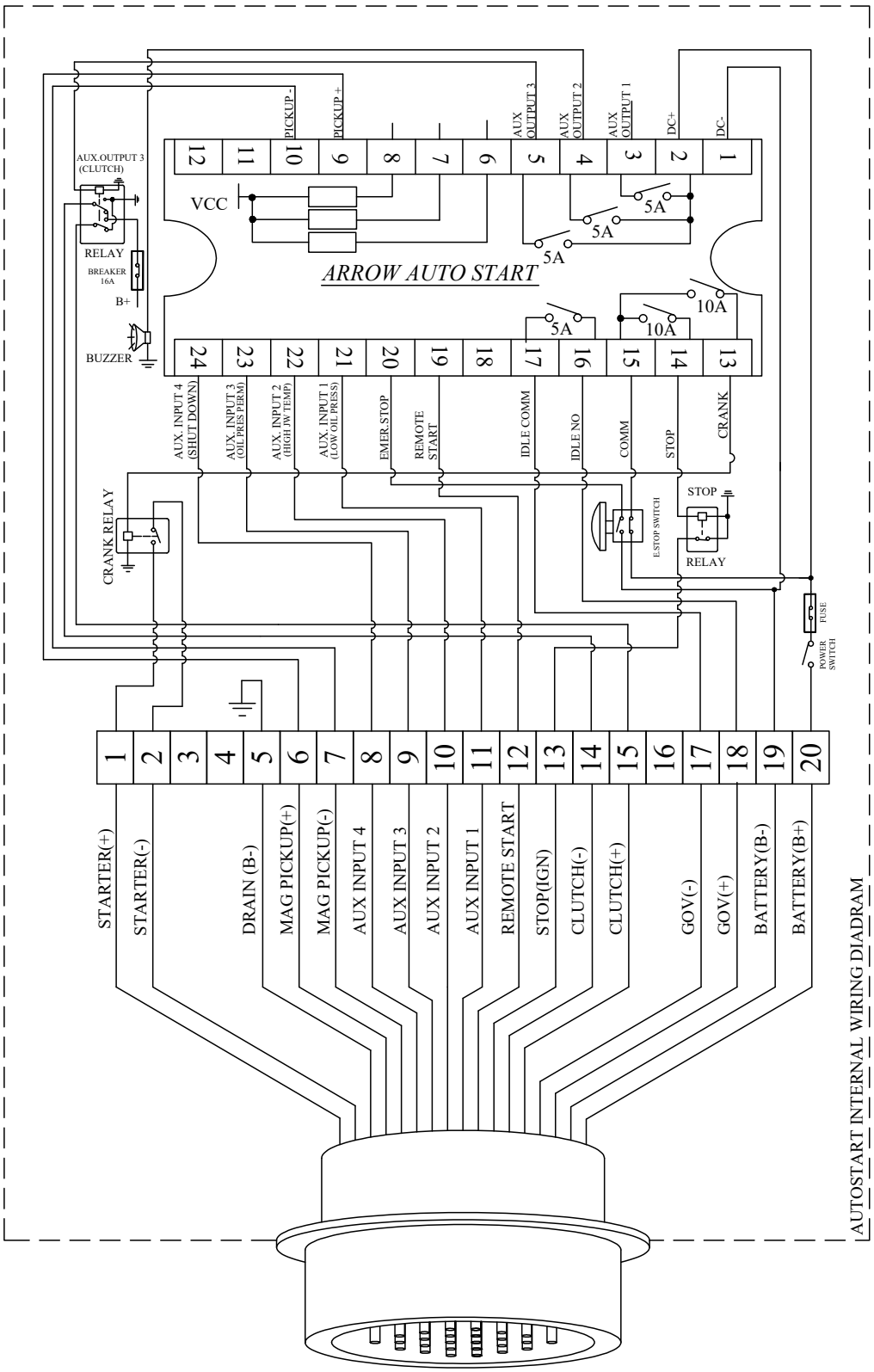
DESCRIPTION	Arrow Part No.
AUTOSTART NS-2 ASSY	AUTOSTART-NS-2-ASSY
AUTOSTART NS-2 24V KIT	AUTOSTART-NS-2-24V-KIT

REPLACEMENT PARTS

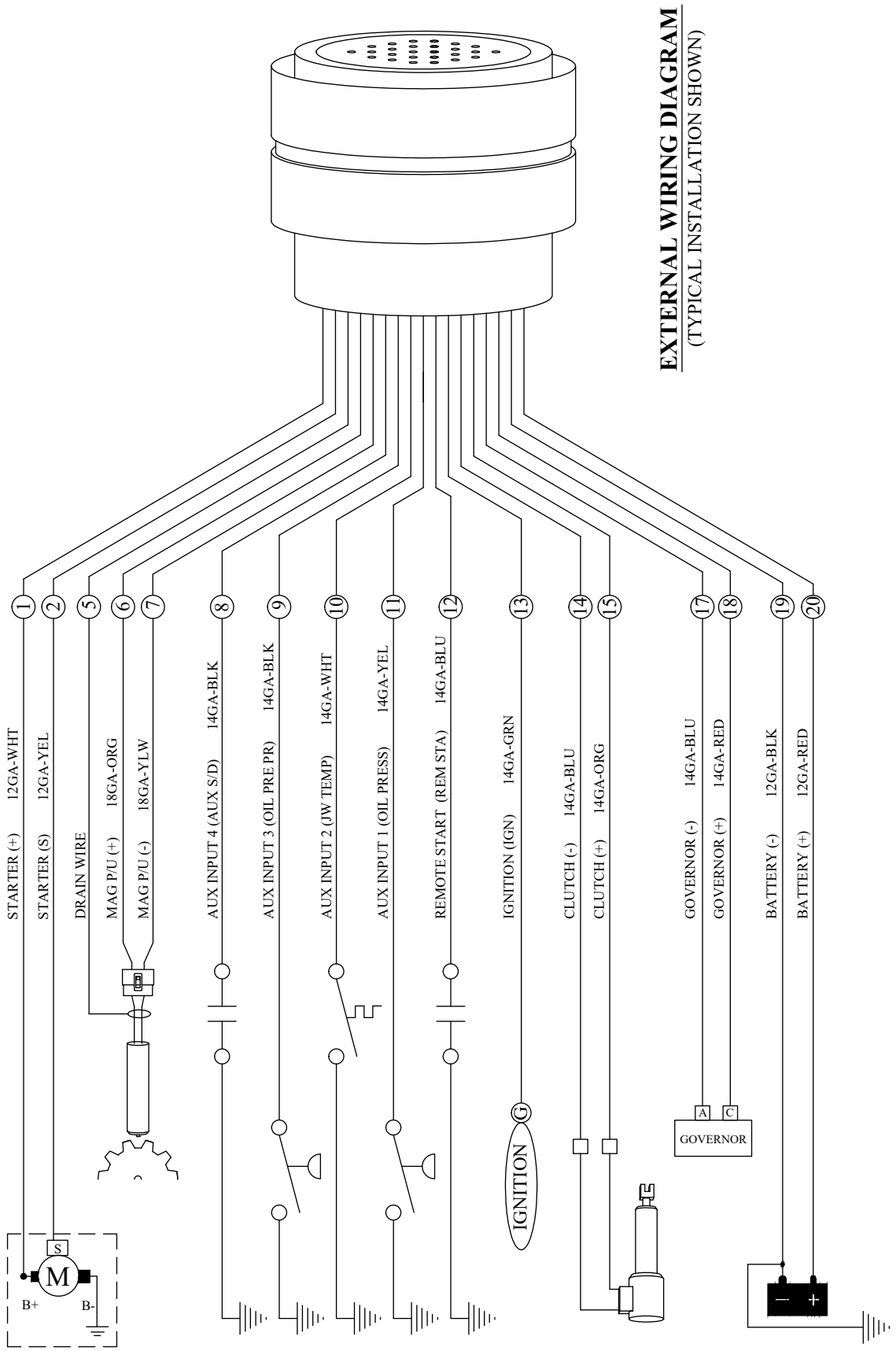
DESCRIPTION	Arrow Part No.
AUTOSTART NS-2 RELAY	AS-NS2-RELAY
AUTOSTART NS-2 RELAY SOCKET	AS-NS2-RELAYSCKT
AUTOSTART NS-2 ESD BUTTON & CONTACTS	AS-NS2-ESDBUTTON
AUTOSTART NS-2 15A BREAKER	AS-NS2-15ABRKR
AUTOSTART NS-2 STARTER SOLENOID	AS-NS2-STARTSOL
AUTOSTART NS-2 BUZZER & LIGHT	AS-NS2-BUZZLIT
AUTOSTART NS-2 ROCKER SWITCH	AS-NS2-ROCKSW
AUTOSTART NS-2 6A BREAKER	AS-NS2-6ABRKR
AUTOSTART NS-2 CONTROLLER	AS-NS2-CONTROLLER

6.0 Wiring Diagrams (with Plug)

6.1 AUTOSTART INTERNAL WIRING DIAGRAM



6.2 AUTOSTART EXTERNAL WIRING DIAGRAM



7.0 Definition of Terms

7.1 SYSTEM PARAMETER DEFINITIONS

PARAMETER	DEFINITION
Trip Speed	When engine starts, if the engine frequency>the trip frequency, it considers the engine started successfully and stops the crank output (trip speed generally set to 1/3 of engine rated frequency).
Gear teeth	The definition of this parameter is related to "speed source option". When "speed source option" is zero, the speed can be obtained by measuring frequency. This parameter is the ratio of speed to frequency, when "speed source" is 1, this parameter is the flywheel teeth of engine.
Change password	Leave factory password 0000.
Address	Only use for multiple equipment networking control, in order to differentiate the equipment.
Analog Set	0– Show hidden display; 1– doesn't show hidden display
Output 1 setting	Auxiliary output definition: 0– SHUTDOWN; 1– Aux STOP; 2– Clutch (LOAD); 3– Automation; 4– Idle(close); 5– Idle(open); 6– Pre-start; 7– Warm up; 8– Acceleration; 9– Deceleration; 10– OVER SPEED; 11– Buzzer; 12– Rated speed; 13– battery low; 14– pumps; 15– alarm.
Output 2 setting	
Output 3 setting	
Output 4 setting	
Input 1 setting	Auxiliary input definition: 0– Monitor; 1– Low oil pressure; 2– High cool temp.; 3– Acceleration limit; 4– Deceleration limit; 5– High JW temp; 6– Low fuel level (alarm but non-stop); 7– High fuel level; 8– Float failure alarm; 9– Alarm; 10– alarm non-stop (running period); 11– alarm stop; 12– Oil pressure permissive; 13– Remote OFF (Aux. shutdown). Definition 16-31 are same as function of definition 0-15, 0-15 effective when they are closed, 16-31 effective when they are cut-off.
Input 2 setting	
Input 3 setting	
Input 4 setting	
Starting Method	0– Detect low oil press when crank; 1– Not Detect low oil press when crank
Display mode	0– Switch in manual; 1– Auto switch
Language selection	0– Chinese; 1– English
Backlight select	0– Auto shut down; 1– Constant light
Speed source select	0– Engine frequency; 1– Speed sensor

7.2 AUXILIARY OUTPUT DEFINITION INSTRUCTIONS

SETTING	TAG	DEFINITION
0	Shutdown	Turns on anytime a shutdown is active.
1	Auxiliary shutdown	Turns on when the engine stop delay is over.
2	Clutch (LOAD)	Turns on after the warm up timer expires. The clutch will be engaged.
3	Automation	N/A
4	Idle (close)	The idle contacts are closed (ON) during these three states: 1) Engine Start, 2) Idle Start, and 3) Idle Stop.
5	Idle (open)	The idle contacts are open (OFF) during these three states: 1) Engine Rated Run, 2) Engine Load Run, and 3) when the engine is not running.
6	Pre-Start	Turns on when the Pre-Start delay is active.
7	Warm-up	Turns on after the Engine Rated speed and before Engine Loaded.
8	Acceleration	Turns on during Acceleration delay.
9	Deceleration	Turns on during Deceleration delay.
10	Over Speed	Turns on when engine is in overspeed.
11	Buzzer	Turns on during the Pre-Start delay and Shutdown. During shutdown, the buzzer will turn off after the E-STOP expires.
12	Rated speed	Turns on when engine is at rated speed.
13	Battery low	Turns on when battery voltage is low.
14	Pumping	N/A
15	Alarm	Turns on when Alarm is active.

*These are configurable settings for AUXILIARY OUTPUTS 1-4.

7.3 AUXILIARY INPUT DEFINITION INSTRUCTIONS

SETTING	TAG	DEFINITION
0	Monitor	N/A
1	Low Oil Pressure	The engine will shutdown when Low Oil Pressure is active.
2	High Cool Temperature	N/A
3	Acceleration Limit	
4	Deceleration Limit	
5	High JW Temperature	The engine will shutdown when Engine JW is active.
6	Low Fuel Level	N/A
7	High Fuel Level	N/A
8	Float Failure Alarm	N/A
9	Alarm	User defined alarm.
10	Alarm Non-Stop	User defined alarm.
11	Alarm Stop	User defined alarm.
12	Oil Pressure Permissive	After engine starts, this signal must be closed before the delay timer expires. If not the engine will shutdown on Low Oil Pressure Permissive.
13	Remote off	N/A

7.4 DELAY TIME DEFINITIONS

DELAY	DEFINITION
Cool Down	When in "Auto" state, after the "Remote Start" switch is turned OFF and auto start/stop cycle is complete the engine will be stopped after Cool Down delay.
Engine Start	When in "Auto" state, after the "Remote start"switch is turned ON, Engine Start delay will be started. After delay time the Pre-start delay will start.
Crank Interval	When cranking, time delay ends, if the engine doesn't start and has not reached the crank times limit, the Crank Interval delay timer will begin. The delay will be repeated and crank times add 1.
Crank Time	When cranking the Crank Time Delay will start. If the engine doesn't start during this time, the Crank Interval will begin.
Bypass Time	After the engine starts successfully, Bypass Time delay starts. "Low oil pressure", "high coolant temp." etc. will not be monitored during the delay to avoid false alarms when engine is starting.
Energize to Stop	Delay used for C series engines when the Ignition STOP relay needs to be held in longer, keeping the Ignition grounded while the engine speed slows.
Pre-start	When an Engine Start is initiated, the pre-start delay begins. During this time the Light/Buzzer will be active. When the timer ends the crank cycle will begin.
Idle Start	After the engine starts successfully, the idle start delay begins. After the timer ends, the engine will go to rated idle.
Idle Stop	When engine stops, the idle stop delay begins. After deceleration is over, the idle relay begins to work.
Acceleration Time	N/A. Leave at zero.
Auxiliary Input 1	Delay begins when the auxiliary input 1 closes. Delay will interrupt when the state is normal. If the input is still closed after delay is over, it will activate alarm. This is used to avoid false alarms.
Auxiliary Input 2	Delay begins when the auxiliary input 2 closes. Delay will interrupt when the state is normal If the input is still closed after delay is over, it will activate alarm. This is used to avoid false alarms.
Auxiliary Input 3	Delay begins when the auxiliary input 3 closes, Delay will interrupt when the state is normal. If the input is still closed after delay is over, it will activate alarm. This is used to avoid false alarms.
Auxiliary Input 4	Delay begins when the auxiliary input 4 closes. Delay will interrupt when the state is normal. If the input is still closed after delay is over, it will activate alarm. This is used to avoid false alarms.
Charger Fail	N/A. Leave at 30.
Low Battery	When battery voltage is lower than limit, delay begins. The delay will interrupt when the state is normal. If the input is still closed after delay is over, it will activate alarm. This is used to avoid false alarms.
Retransformation	When in "Auto" state, after the "Remote Start" switch is turned ON, Retransformation delay will begin. After delay time, the Engine Start delay will start.
Loss Speed	Delay begins when there is no speed signal while running. If the speed signal is not detected during the delay, then Loss Speed alarm activates.
Over Speed	Delay begins when engine speed is over limit, and alarm activates when delay ends. If the speed becomes normal, delay will be interrupted.
Under Speed	Delay activates while engine running at rated speed. If speed is lower than low limit, delay will begin. When speed becomes normal, delay will be interrupted. When delay is over, speed is under setpoint, then alarm Under Speed activates.
Warm Up	After engine starts successfully, and the speed reaches rated speed (SPEED> Min Load Speed), the "Warm Up" time delay begins. After "warm up" time ends, engine run load will begin.
Deceleration	N/A. Leave at zero.

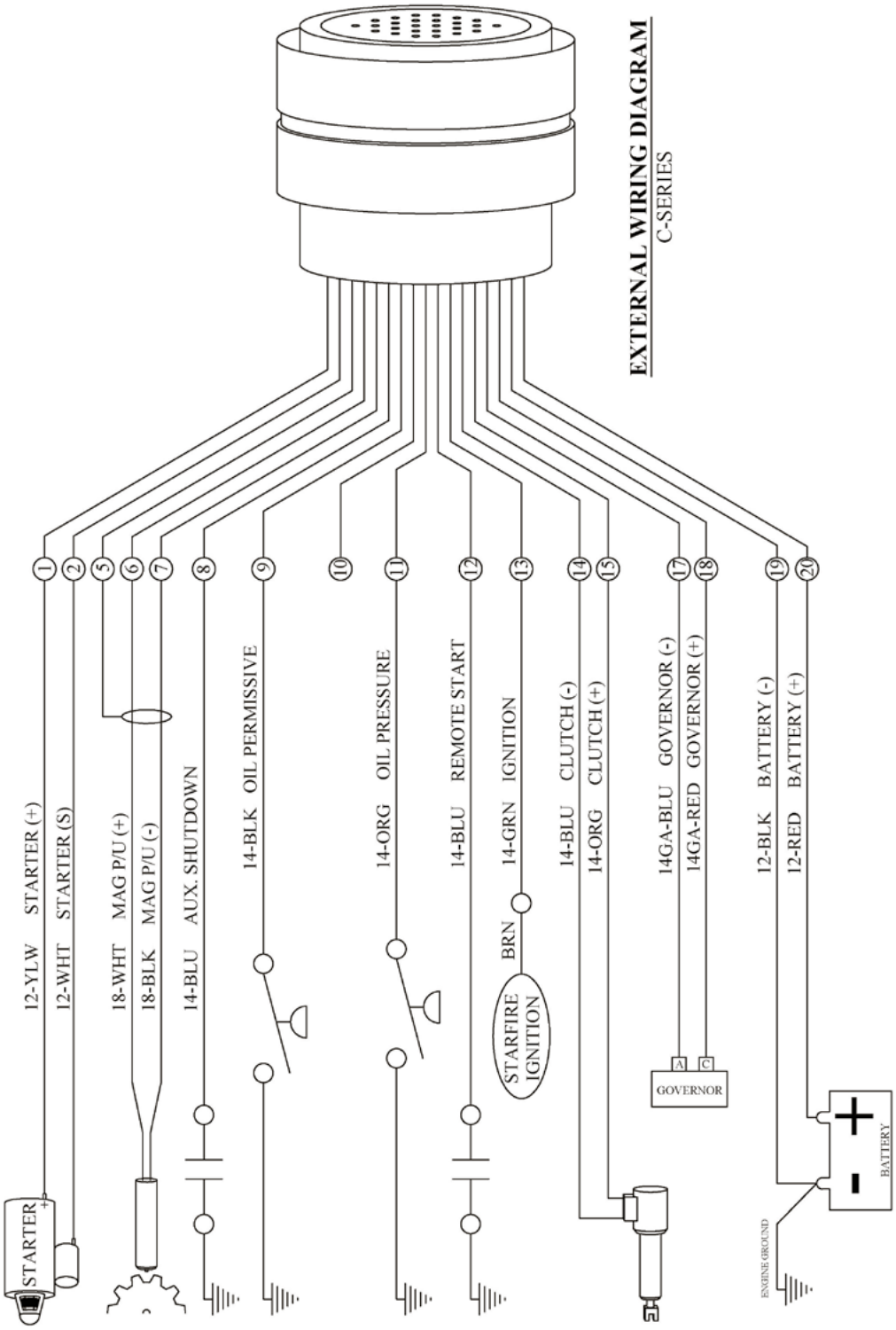
8.0 Troubleshooting

8.1 TROUBLESHOOTING

FAILURE	DESCRIPTION	SOLUTION
Manual start failure	Press Start key, the green light is on and the motor doesn't work.	Check the menu of "low oil pressure" in the "input port state", if display is "0", check whether the oil pressure sensor is ok; if display is "1", the oil pressure sensor is ok. Press start key, using a multimeter to confirm there is 12V. If no output, the module might be damaged. If the voltage is 12V, check whether the start relay is energized. If relay is energized, check "S" signal at starter. Also check the voltage output in battery.
Auto start failure	Module in Auto state, the "remote start" state light is ON and the motor doesn't work.	Check the status of "remote start" in the "input state." If the "remote start" displays "0" it means that the remote input signal is not active. If it displays "1", the module might be faulty.
Crank	After successful start the starter motor keeps running.	Lower the trip speed.
No speed indication	No RPM display when the engine is cranking.	Verify the mag pick-up is installed correctly, and the tip of the sensor is clear of metal filings. Adjustment of the sensor in/out might be required.

9.0 Reference Drawings

9.1 C-SERIES EXTERNAL WIRING DIAGRAM



9.2 Ford 300 SETTINGS

9.2.1 ALARM LIMIT SET

DESCRIPTION	C-SERIES	FORD 300
ACCELERATION LIMIT	100	50
DECELERATION LIMIT	400	800
RESERVED	0	0
HIGH SPEED ALARM	900	2000
LOW SPEED ALARM	200	750
OVER SPEED	1000	2500
MIN LOAD SPEED	350	700
HIGH COOLANT TEMP	-	-
HIGH FUEL LEVEL	-	-
LOW FUEL LEVEL	-	-
LOW BATTERY LEVEL	85	85
LOW CHARGER	80	80
LOW OIL PRESSURE	-	-

9.2.2 MEASURE REGULATE

DESCRIPTION	C-SERIES	FORD 300
BATTERY VOLTAGE	-	-
CHARGER VOLTAGE	-	-
COOLANT TEMP	-	-
OIL PRESSURE	-	-
FUEL LEVEL	-	-

9.2.3 DELAY TIME SET

DESCRIPTION	C-SERIES	FORD 300
COOLDOWN	2	20
ENGINE START	0	0
CRANK INTERVAL DELAY	30	15
CRANK TIME	20	8
BYPASS TIME	25	25
ENERGIZE TO STOP	3	0
PRE-FUEL(START) DELAY	5	5
IDLE START DELAY	10	5
IDLE STOP DELAY	10	15
ACCELERATION TIME	0	0
AUX. INPUT 1 DELAY	2	5
AUX. INPUT 2 DELAY	0	5
AUX. INPUT 3 DELAY	2	2

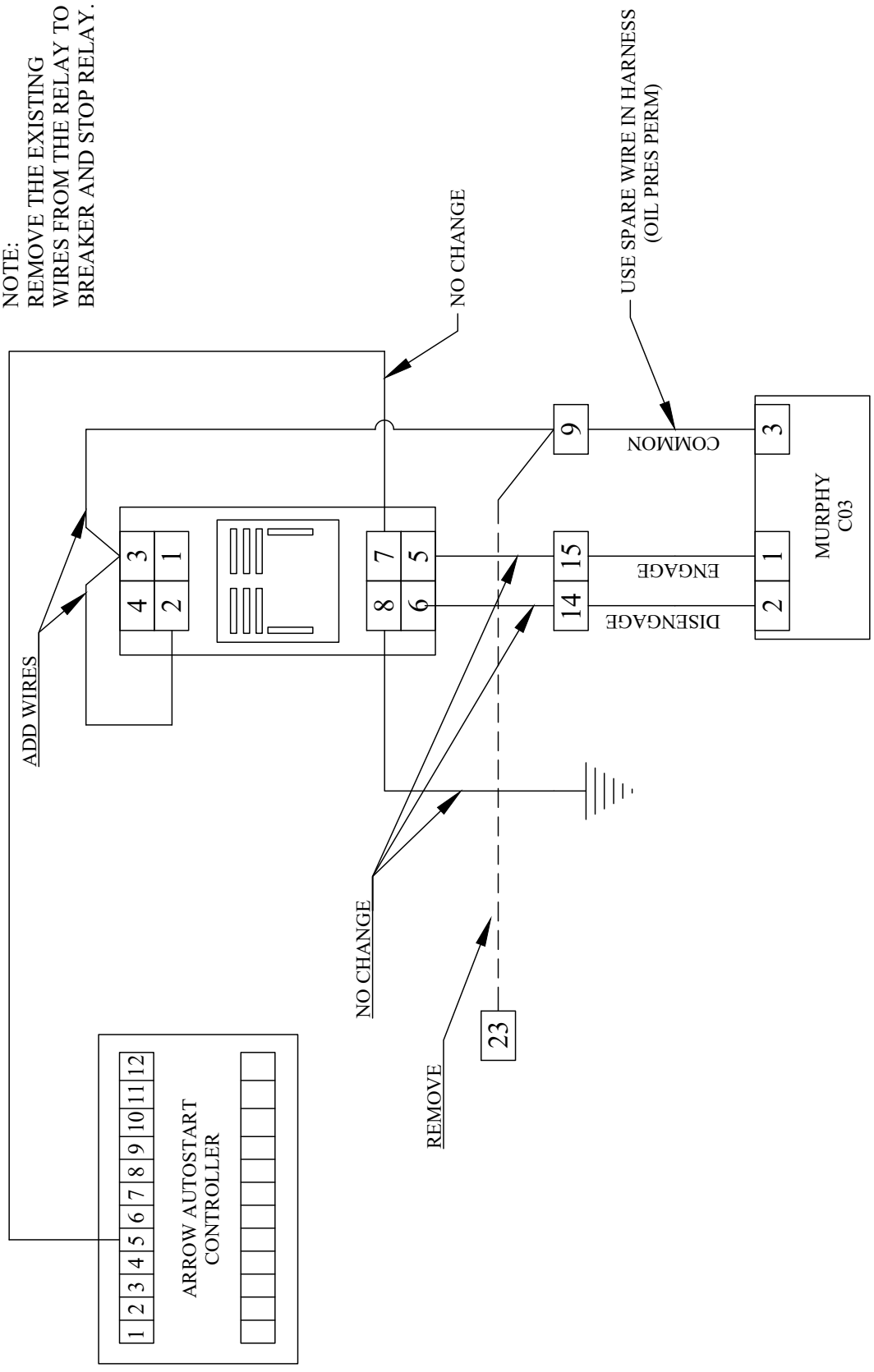
DELAY TIME SET (continued)

DESCRIPTION	C-SERIES	FORD 300
AUX. INPUT 4 DELAY	0	0
CHARGER FAIL DELAY	30	30
LOW BATTERY DELAY	20	20
RETRANSFORMATION DELAY	2	2
LOSS SPEED DELAY	3	1
OVER SPEED DELAY	5	5
UNDER SPEED DELAY	10	10
WARM UP DELAY	10	60
DECELERATION DELAY	0	0

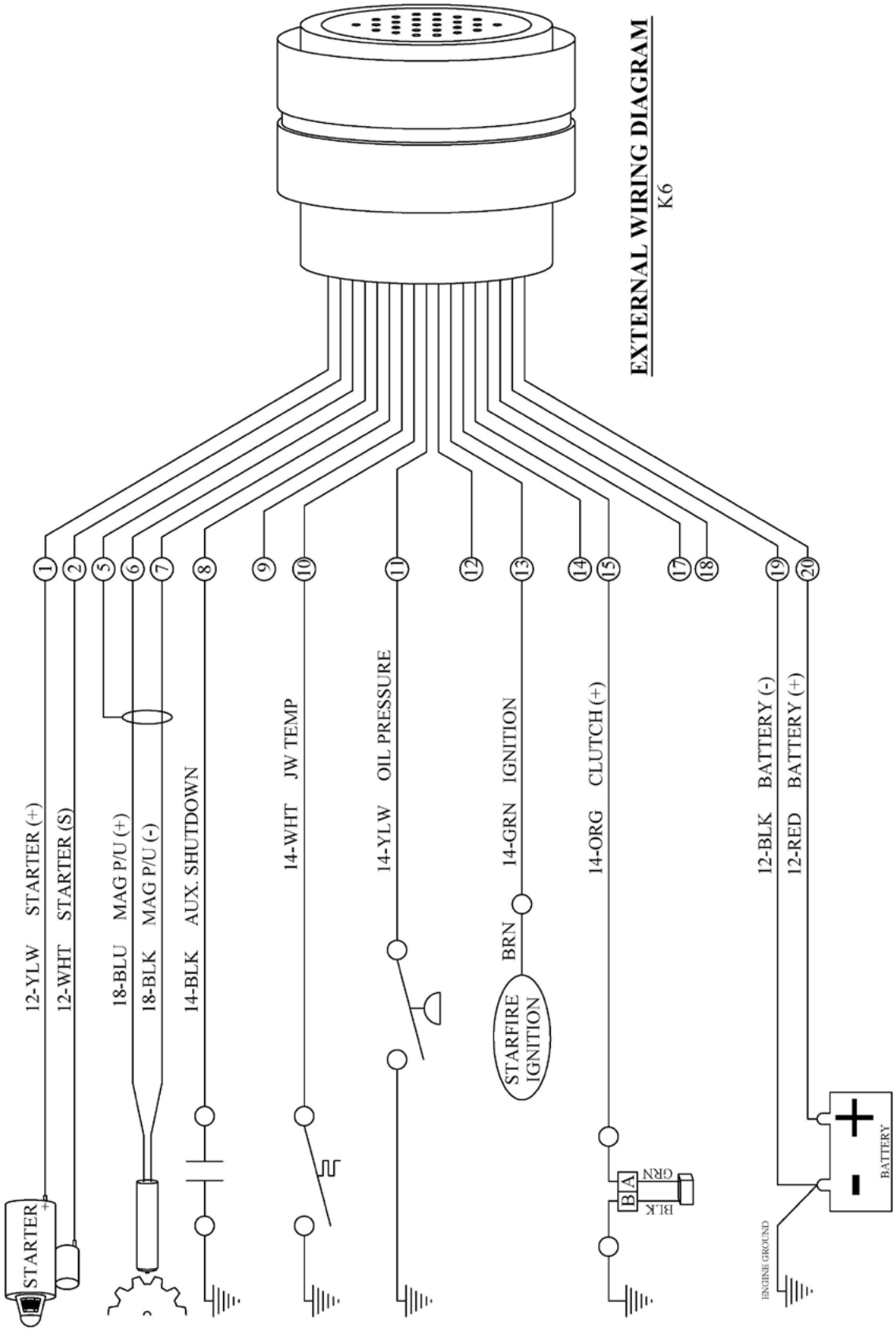
9.2.4 SYSTEM SET

DESCRIPTION	C-SERIES	FORD 300
TRIP SPEED	200	300
GEAR TEETH	200	182
PASSWORD**	0	0
ADDRESS	120	120
ANALOG SET	1	1
OUTPUT 1 SET	1	1
OUTPUT 2 SET	11	11
OUTPUT 3 SET	2	2
OUTPUT 4 SET	4	4
INPUT 1 SET	1	1
INPUT 2 SET	5	5
INPUT 3 SET	0	0
INPUT 4 SET	11	11
CRANK METHOD	0	0
DISPLAY MODE	0	0
LANGUAGE	1	1
LCD MODE	0	0
SPEED SOURCE	1	1

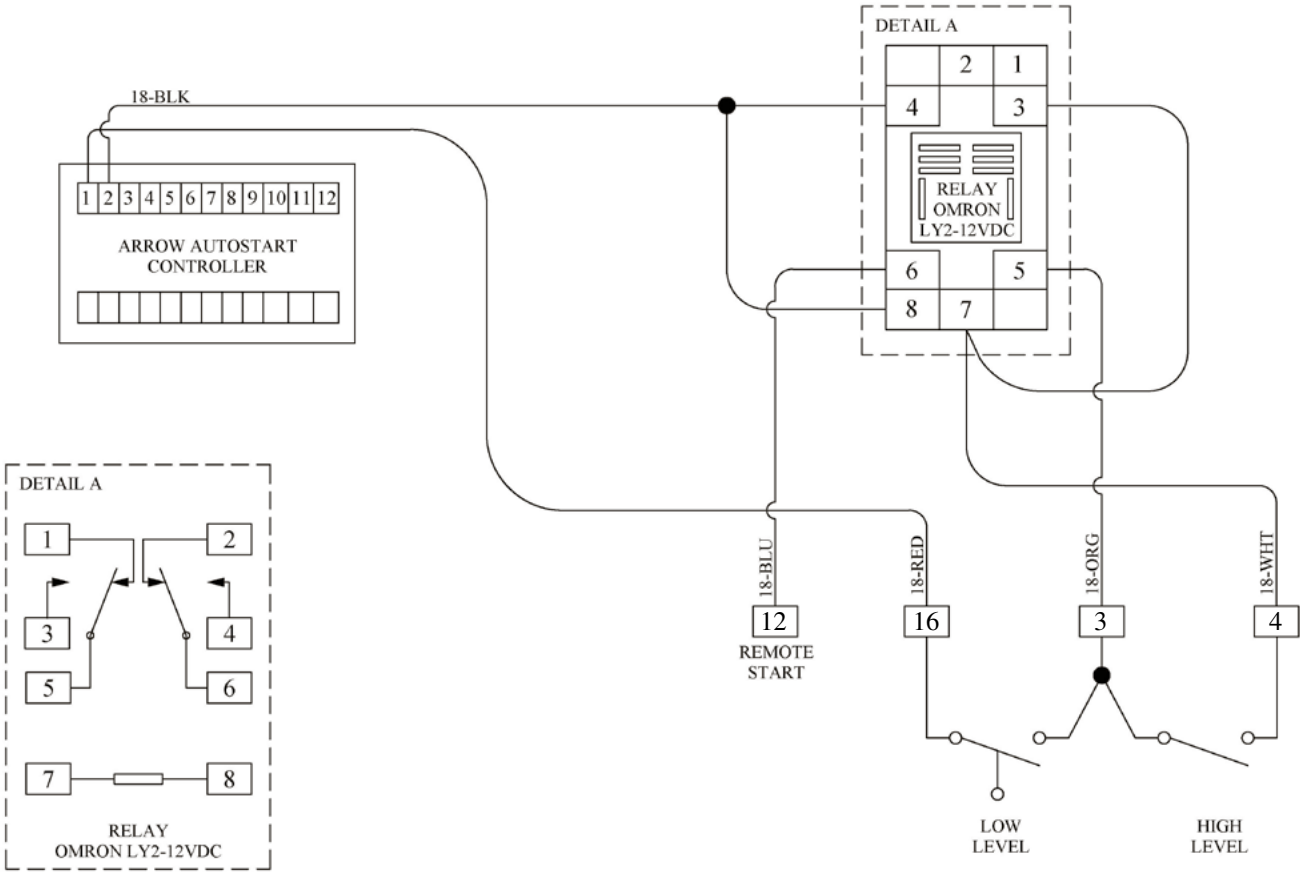
9.3 MURPHY CO3 ACTUATOR



9.4 K6 EXTERNAL WIRING DIAGRAM



9.5 Tank Level Controller



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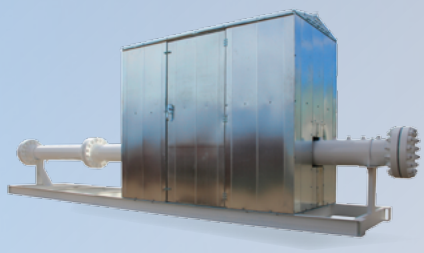

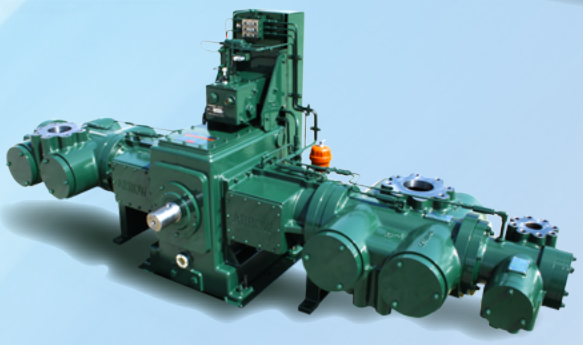

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