

Specifiche tecniche technical specification description technique

borghi & saveri s.r.l.

Via Provinciale per Bologna, 28-30 - 40066 PIEVE DI CENTO (BOLOGNA)
Telefono 051/97.53.64 - 97.53.65 - Tlx 512184 BS BOL I - Fax (051) 97.35-84

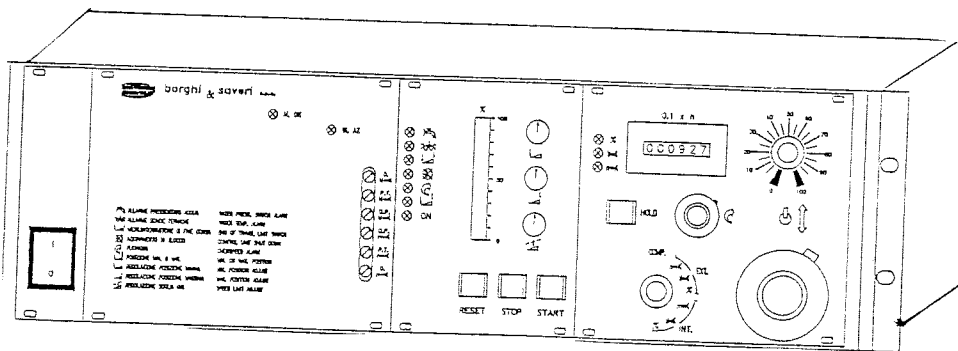
SHEET NO. 1

I N S T R U C T I O N M A N U A L

MODELLO SAT/AT.4419
SERIAL NUMBER: 4.092.069

CUSTOMER: _____

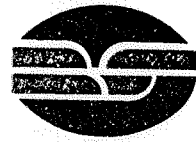
MECHANICAL ACTUATOR AT 4419
CONTROL UNIT SAT



WARNING

WHEN ASKING FOR SPARE PARTS AND IN ALL CORRESPONDENCE THE CUSTOMERS ARE KINDLY REQUESTED TO INDICATE THE MODEL AND THE SERIAL NUMBER OF THE EQUIPMENT.
THE IDENTIFICATION DATA ARE SUMED UP IN TWO PLATES FIXED ON THE COVER OF THE ACTUATOR AND ON THE BACKPANEL OF THE CONTROL UNIT SAT.

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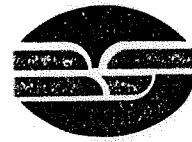
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SHEET NO. 2

T A B L E O F C O N T E N T S

- 1- TECHNICAL AND FUNCTIONAL FEATURES
- 2- MECHANICAL INSTALLATION
- 3- ELECTRICAL WIRING
- 4- USER'S INSTRUCTIONS
- 5- OPERATING MODES
- 6- FAULT FINDING
- 7- MAINTENANCE
- 8- SPARE PARTS
- 9 ELECTRICAL DIAGRAMS

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1 MECHANICAL ACTUATOR AT 4419 WITH SAT CONTROL UNIT

TECHNICAL / OPERATION FEATURES:

- . Cast aluminium alloy fabricated base, accurately machined, suitable to house all actuator components.
- . High precision rotatory transducer, for position feedback signal.
- . Tacho generator for speed feedback signal.
- . D.c. electric motor, permanent magnets type, of high dynamic performance.
- . Rack and pinion gearing, to change the motion from rotatory to linear.
- . "FLEXBALL" flexible cable, suitable for push and pull operation, length 1.5 metres approximately.
- . Control unit SAT.
Metal case for 19" Rack, with front control panel. The electronic module adjusts the opening and closing of the carburettor throttle or of the injection pump lever.

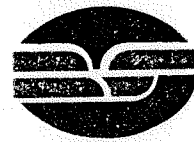
Available control modes are:

- 1) Percentage or position control (%) - (α).
Control accuracy within $\pm 0,5\%$ of the stroke.
- 2) Constant speed control $n = K$.
Control accuracy within $\pm 0,5\%$ of the speed full scale.
- 3) Constant torque control $M = K$.
In this control mode it is necessary a $0 \div 10$ V c.c. load cell amplifier (see the module MP 620 V or MP 630 S1).
Control accuracy within $\pm 0,7\%$ of the torque full scale.

N.B. WITH LOAD CELL AMPLIFIER NOT PRODUCED BY US, WE CAN NOT GUARANTEE THE CONTROL ACCURACY.

The above described control modes may be performed by front panel or by remote demand (via an external potentiometer) or by a $0 \div 10$ V d.c. control signal from programmer.

- . 13 metres multicore cable loom, with wired connectors for connection between mechanical actuator and control unit.
Longer lengths are available on special request at extra charge.



NB: If the customer does not connect the equipment according to our original wiring diagrams, or modifies any connection, we will not be responsible for any arising damage and guarantee will be cancelled.

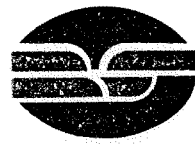
PRINCIPLE OF OPERATION

The system comprises two main units:

- A) Mechanical Actuator AT-4419.
- B) Electronic control unit SAT.

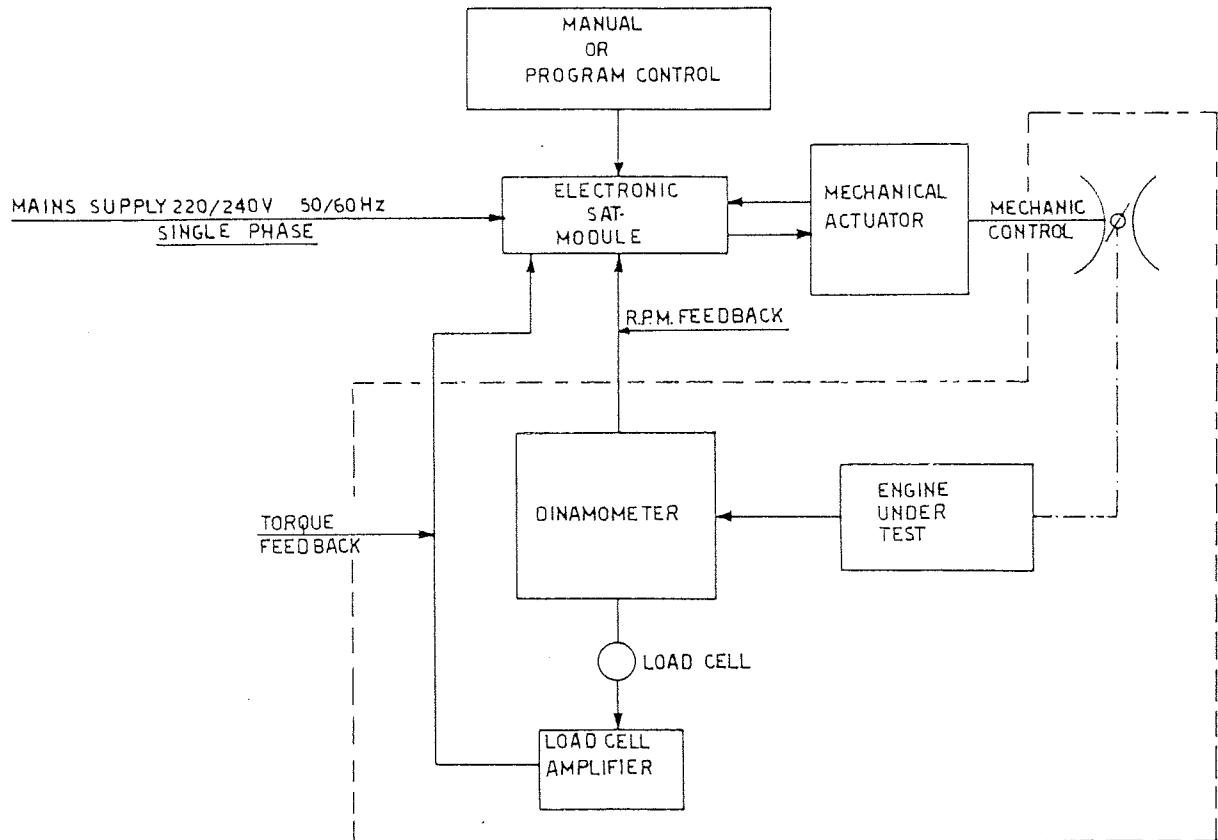
The mechanical actuator, by means of an high performance d.c. electric motor, with a rack and pinion gearing which changes the motion from rotatory to linear, adjusts the throttle or the injection pump lever opening. A high accuracy rotatory transducer gives the signal of the position feedback.

The command (demand) of position to the throttle valve or to the injection pump lever, comes from the controller and reaches the d.c. electric motor, which adjusts the accelerator opening position, via a flexible cable "FLEXBALL" suitable for pull-and-push action (see figure 1 schematic diagram).



Block diagram

SHEET NO. 5



NB. All parts inside dashed line are not included in standard delivery.

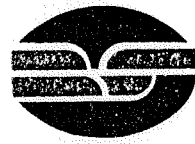
Each control mode may be set manually from the front panel selector or automatically from a computer, shorting suitable external contacts.

"Position" mode allows direct closed loop control of the engine throttle lever position, irrespective of loading and other factors which may affect the engine speed and power output.

Constant speed and constant torque are closed loop control modes, achieved by comparing the feedback signal from the dynamometer with the demand (command) signal and using amplification of the resultant error to adjust the throttle position, thereby maintaining the set value of the selected parameter within close limits.

To provide these capabilities the controller embodies a high accuracy three terms PID (proportional, integral and derivative/-rate) servo amplifier for each control mode. All three terms are independently adjustable to ensure optimum stable control of the engine under test.

A led bar display continuously shows the throttle percentage opening.

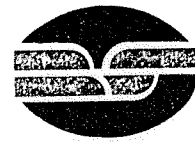


TECHNICAL CHARACTERISTICS

Limit temperature with not operating module	:	- 10 degrees °C / + 70 degrees °C
Operating ambient temperature of the electronic control module	:	0 degrees ÷ 40 degrees °C
Singlephase mains supply	:	110 / 220 / 240 V. 50/60 Hz
Different mains supply	:	On request
Mains supply tollerance	:	+ 10% - 15%
Ground connection	:	Compulsory according to safety rules
Mechanical actuator supply	:	With electronic module
Max Current absorption	:	5A
Max. power absorption	:	1,2 KW
Humidity	:	0 ÷ 90% non condensing

PERFORMANCE

Maximum positioning force	:	20 Kg.
Maximum stroke	:	100 mm.
Stroke adjustment	:	80 mm
Stroke setting range	:	20 ÷ 100 mm
Max stroke positioning time	:	400 milli-sec with full load
Electronic idle position shift	:	40 mm. with potentiometer
Mechanic idle position shift	:	80 mm with ring nut
Position control accuracy	:	± 0,5 mm
RPM control accuracy	:	± 0,5% speed full scale
Torque control accuracy	:	± 0,7% torque full scale
With B.S. load cell amplifier Position analog output	:	0 ÷ 10 V. d.c. proportional to actual opening of the throttle or of the injection lever pump
Accuracy	:	0,5% of f.s. 10 V. = 100%
Weight	:	24 Kg



N.B.: Starting from a minimum stroke of 20 millimeters is possible to connect directly the throttle actuator to the engine accelerator.
If the required stroke is shorter than 20 mm it is necessary to put between a lever so as to increase the actuator stroke.

ALARMS AND SAFETY SYSTEMS

All the alarms are of "transparent memory" type, i.e. they can not be reset whilst the cause of the alarm persists.

- 1) Overtemperature of the switched mode output stage power transistors.
This alarm is triggered when the temperature of the power transistors case exceeds 70 degrees C.
This alarm is lumped together with the end of stroke microswitch which protects the mechanical ends of the stroke.
(The two safety contacts are connected in series).
- 2) Internal supply alarm/control unit shut down.
It is triggered when:
 - . Feedback connections of the d.c. motor are missing or interrupted.
 - . D.c. motor is shorted or damaged.
 - . Temporary or permanent mains undervoltage or internal supplies are non-functional.
 - . The switched mode power output stage is not working.
- 3) Overspeed alarm.
It is triggered when:
 - . The engine speed exceed that set by the "overspeed" potentiometer on the front panel.
 - . The speed pick-up is not connected or its cable is interrupted or stripped.

The overspeed alarm always operates immediate return to idle position of the actuator.

It is also possible to connect two external alarms with normally closed contacts.

Each of above alarms is led displayed and connected to a relay, that duly wired to customer's care, stops the test engine.

Two fuses on the input supply lines to the power and control circuits are provided as additional protection.

SAFETY RULES

It is responsibility of the installer, to mount, upstream our electronic equipment, an insulation transformer and the safety devices provided for by law.



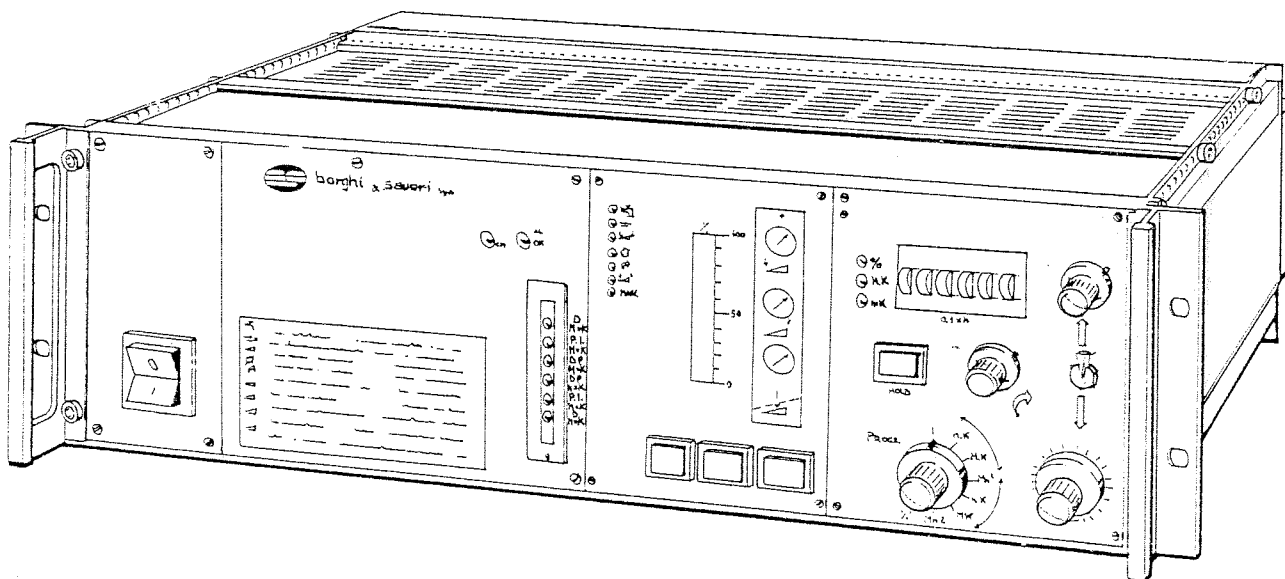
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SHEET NO. 8

The safety rules also provide for connection of the equipment to an earth plate.
The manufacturer declines all responsibility in case of non compliance with these rules.

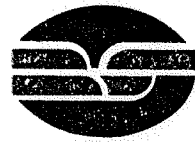


DIMENSIONS AND WEIGHT

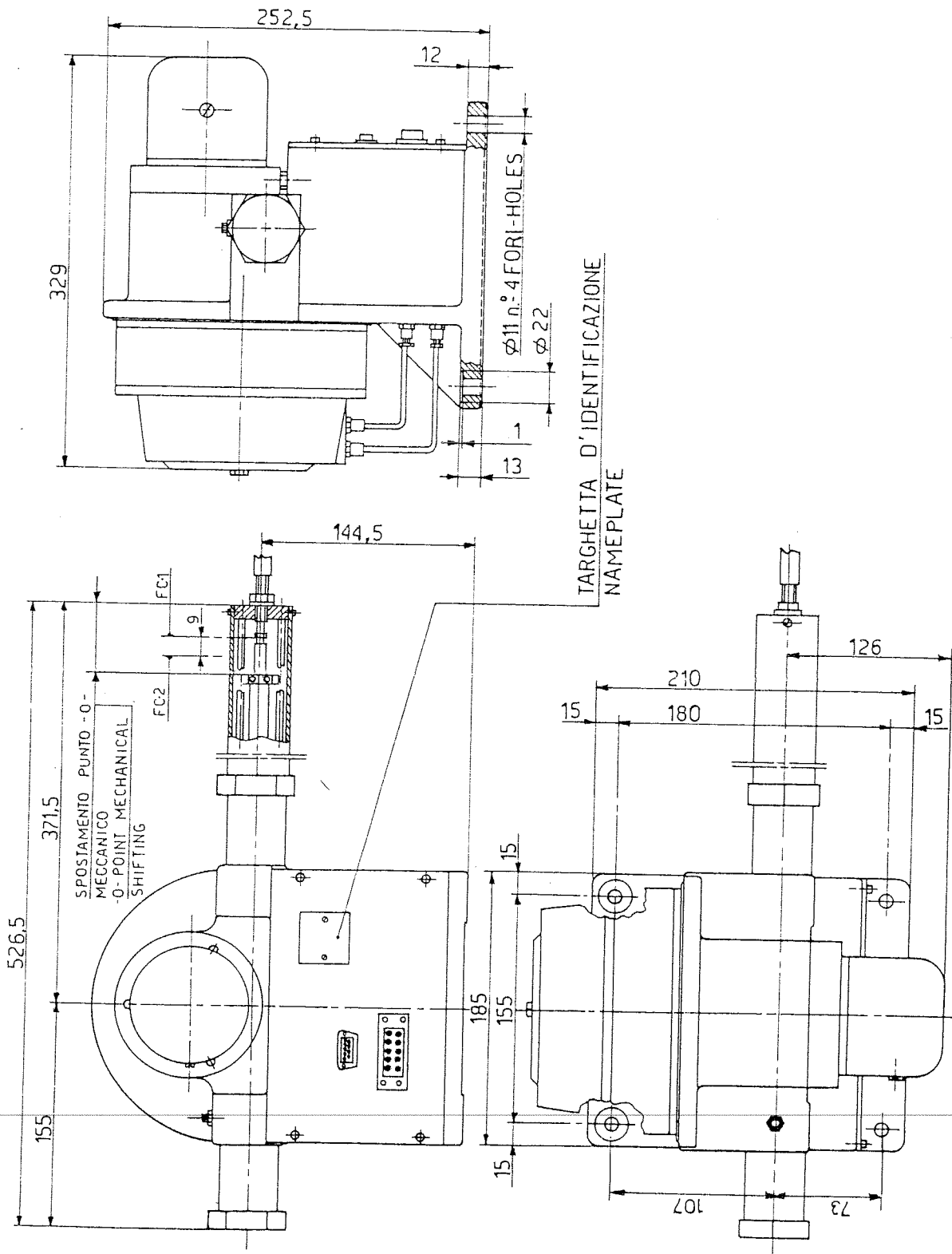
WIDTH : 483 mm (19") front panel
HEIGHT : 134 mm (3U)
DEPTH : 490 mm including the connectors
WEIGHT : 15,200 Kg.

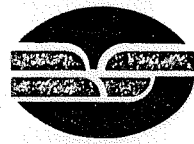
NB: If the box is mounted in a panel (or in a cabinet), a clearance hole of 448 x 134 mm should be provided.

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MECHANICAL ACTUATOR OVERALL DIMENSIONS





2 MECHANICAL INSTALLATION

2.1 The actuator mechanical body has to be installed near the engine under test, at a maximum distance of about 1.5 metres, and insulated from the engine to avoid the transmission of vibrations.

For an excellent working of the actuator is necessary to exclude all mechanical plays between the Flexball cable and the engine accelerator lever and to put on the ball joint for fixing the sheath directly to the engine (sheet 11).

On request is supplied a suitable column for a correct installation.

It is a good rule to install the actuator far from heat sources, since the operating temperature must not exceed 60 degrees.

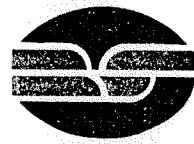
It is also necessary to avoid the contact of the actuator body with whatever liquid (water, oil, petrol etc.) being standard protection degree IP 54.

The mechanical connection with the engine under test is made by means of a flexible push-pull cable "Flexball", fixed to a rod which is integral with a gear bar moved by a pinion directly coupled to the d.c. motor spindle.

This connection allows pull and push action avoiding vibrations transmission to the d.c. motor.

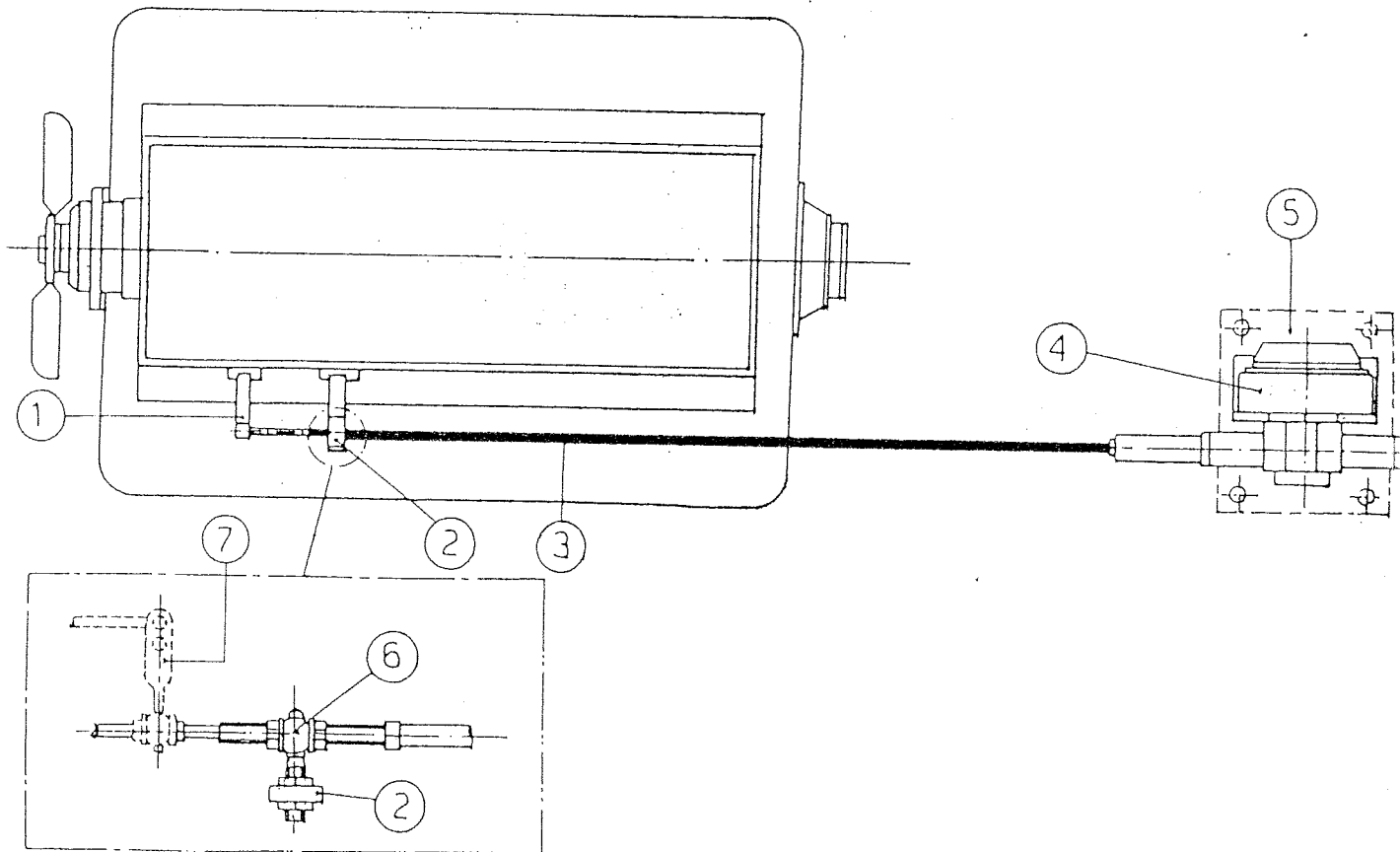
If you do not use the flexball cable avoid in every case the use of not rigid elements like springs, chains or similar.

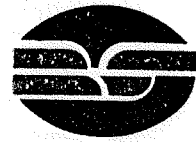
The throttle position signal (position feedback) is given by an high accuracy rotary transducer (potentiometer). The transducer spindle is moved from a gear mechanically coupled with the d.c. motor shaft. On the opposite side of the transducer spindle is mounted a cam which can operate an end of stroke protection microswitch. This safety device avoids that wrong or non effected calibrations can cause damages to the actuator.



SUGGESTED INSTALLATION DIAGRAM OF THROTTLE ACTUATOR WITH
"FLEXBALL" CABLE.

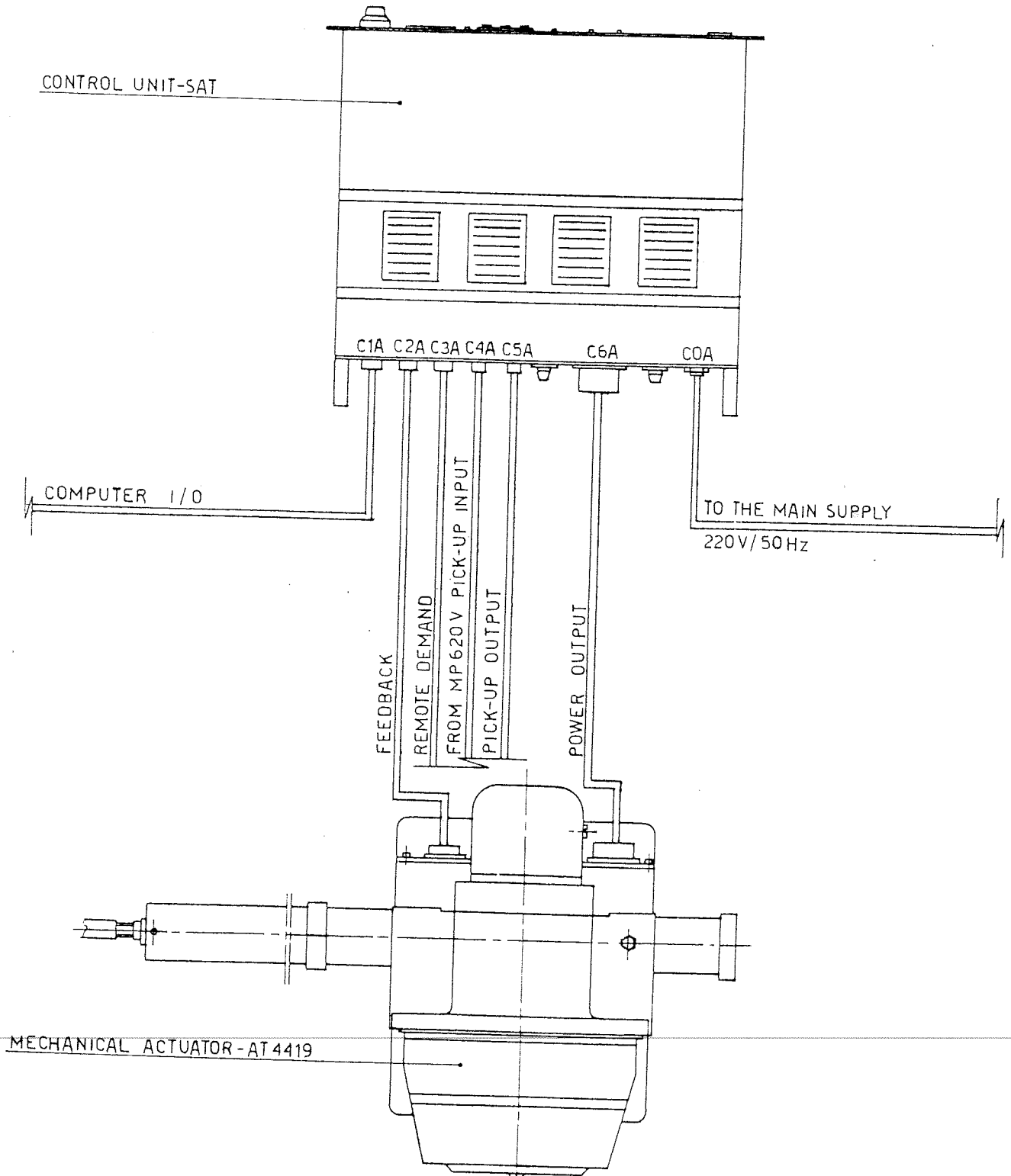
- 1 ENGINE THROTTLE LEVER
- 2 CABLE SHEATH BLOCKING BRACKET
- 3 "FLEXBALL" FLEXIBLE CABLE
- 4 MECHANICAL ACTUATOR
- 5 COLUMN SUPPORT
- 6 BALL JOINT
- 7 CONTROL LEVER. FOR STROKE REQUIRED SHORTER 20 MM, IT IS NECESSARY TO EXTEND THE CONTROL LEVER

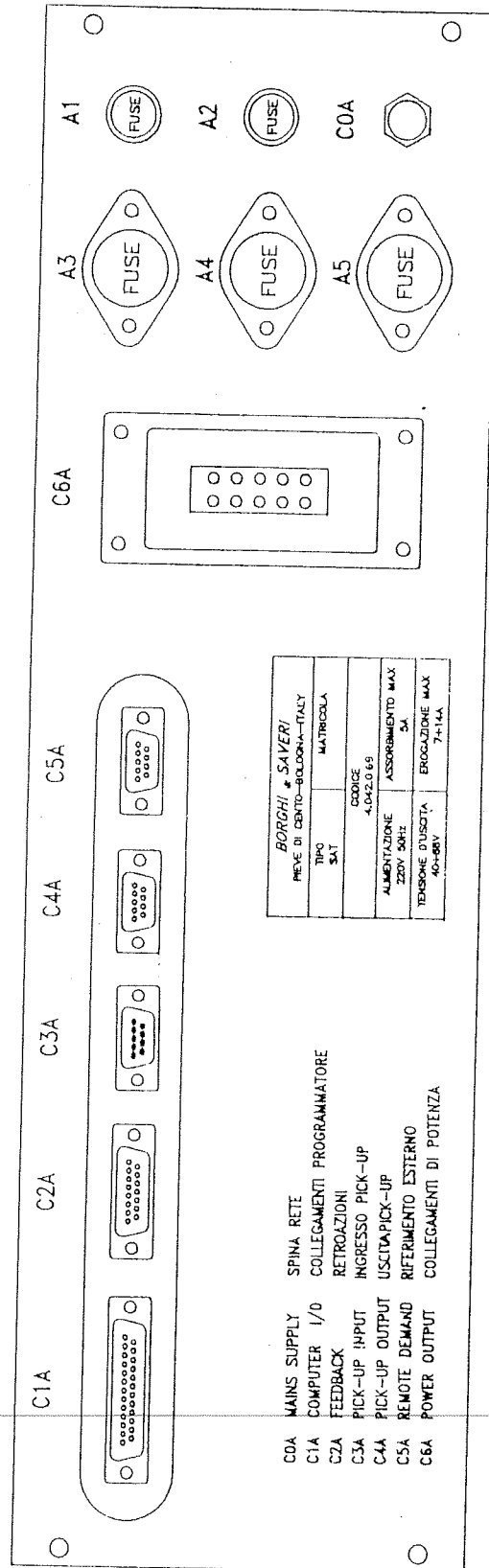
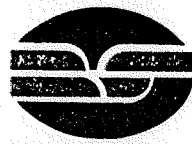


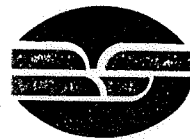


3 ELECTRICAL WIRING

ELECTRICAL WIRING







4 USER'S INSTRUCTIONS

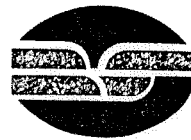
4.1 Calibrations to be performed on the first installation

The following operations have to be performed after having installed the mechanical actuator and the electronic control unit. In the following description we make reference to the enclosed sheet 11.

After being sure that all electrical wiring has been correctly made perform the following operations strictly in the order hereunder listed:

- . Switch on the control unit.
- . Ensure that the two green leds BL.AZ. and AL.OK. are on, so indicating correct internal feeding voltages.
- . Ensure that the two trimmer potentiometers C061 and C062 marked "minimum position" and "maximum position" are both set to zero.
- . Turn fully clockwise the control mode selector C077, i.e. in position % int.
- . Check that both adjustment potentiometers, coarse C081 and fine C083 are set to zero.
- . Select the fine adjustment potentiometer switching downward the lever C082.
- . Using the key equipping the actuator move the gear bar rod at the end of stroke FC-1 (rotating the key fully clockwise); then rotate in the opposite direction (counterclockwise) bringing the rod back in position FC-2 (sheet 9).
- . Press the button "RESET"; this will light up all the pilot leds for 2/3 seconds; if no alarm is on all the leds will be extinguished. If one of the lamps stays "on", look for the cause and remove it, otherwise the control unit does not start.

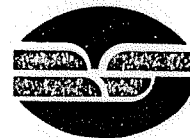
BEWARE: IF THE EXTERNAL CONTACTS "START", "STOP" AND "RESET" (DRAWING 9-1331) ARE NOT USED, IT IS NECESSARY TO MAKE A SHORT CIRCUIT BRIDGE BETWEEN PIN 17 AND 18 OF THE CONNECTOR C1A. WITHOUT THIS SHORT CIRCUIT THE CONTROL UNIT DOES NOT START.



- . Press the button "START"; the yellow led "ON" will light up and at the same time you will hear a slight whistle coming from the mechanical actuator. This whistle is normal and typical of the correct equipment operation, the actuator has to remain standing in the idle position.
- . Connect the "FLEXBALL" cable to the actuator body screwing the sheath 41, Drawing 4419-74, to the cover 44 and fixing the steel cable to the rod 47 with the nut 46.
- . Connect the other end of "Flexball" cable to the test engine (carburettor or injection pump), in the minimum position, fix stiffly the sheath to the engine block and the steel cable to the lever, even making the suitable fittings with support brackets (if necessary) in order to avoid elasticity or clearances in the control of the lever.
- . Now provide to calibrate the maximum opening of the accelerator lever: for this rotate slowly clockwise the potentiometer C083, sheet 17, up to its maximum position, checking at the same time the movement of the accelerator lever of the engine under test.
During this operation the bar grap C058 will light up progressively. If with the potentiometer C083 set to the maximum is not possible to reach the accelerator full stroke, is necessary to adjust the trimmer C062 marked "max. pos." on the control unit front panel. With a small screwdriver turny it very slowly clockwise until reaching the accelerator full stroke.
All the above operations have to be done with the engine under test stopped.
- . Neither in minimum position nor in maximum position has to remain permanently lit the yellow led C056 signalling that the electric motor is under stress. If this occurs the d.c. motor is forcing against a mechanical block (max. or min. end of stroke of the engine accelerator lever) and by consequence the stroke calibration has not been made correctly and it is necessary to remake it.

VERY IMPORTANT: NEVER WORK WITH THE YELLOW LED C056 PERMANENTLY LIT (SEE ALSO NOTES ON SHEETS 15 AND 21). IN THESE OPERATING CONDITIONS THE ELECTRIC MOTOR IS UNDER STRESS AND WILL BE HEAVILY AND PERMANENTLY DAMAGED.

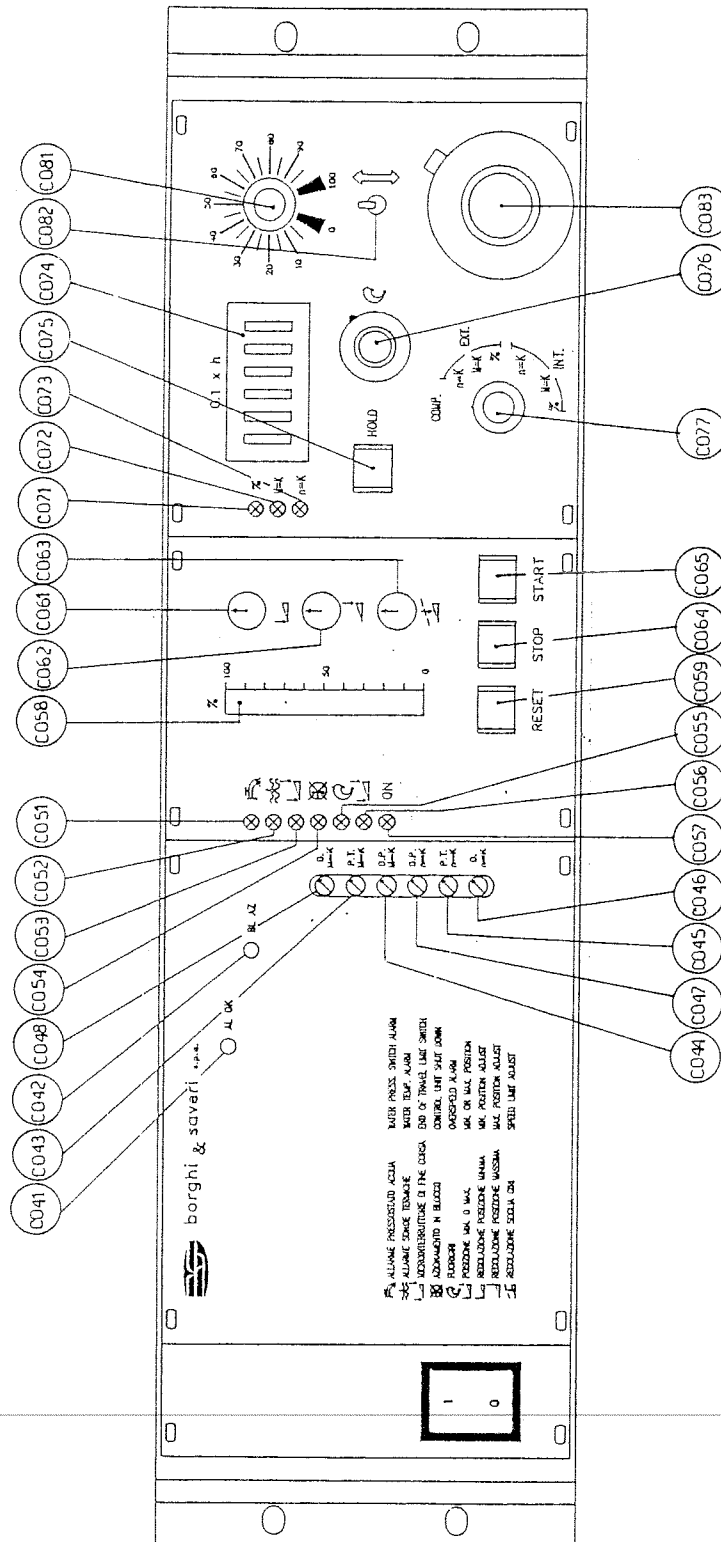
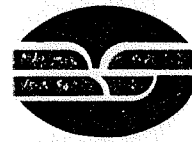
- . The correct calibration should be already achieved: try some times to move clockwise and counterclockwise the fine regulation potentiometer checking if the accelerator stroke is regular and free of possible mechanical locks.

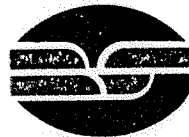


- . Switch upward the lever C082 selecting the coarse adjustment potentiometer and move it several times; the accelerator control will be faster but always limited between min. and max. previously calibrated.
- . Set the "overspeed" potentiometer to the absolute maximum speed of the engine under test.
At every unit read in the black square on the knob correspond 1000 rpm (standard calibration). Hundreds and tens are read on the vernier graduated scale marked on the knob.
If the engine speed exceeds the preset limit, the actuator goes immediately to idle position and the "overspeed" red led lights up.
To operate again press "RESET" button.
The "minimum position" may be varied, respecting the standard calibration, adjusting the "min. pos." trimpot. Note that this will change also the "max. pos.", so if this calibration has just been done is necessary to do it again.
- . While securing "Flexball" cable may occur that the actuator control rod shifts its position operating the end of stroke microswitch (20). To reset this alarm move a bit forward (or backward) the cable rod 47 until the microswitch is deactivated, using the suitable key through the hole on the cover 6 after removing the sealing cap 2. If the microswitch is activated the control unit stands in an alarm state and the red led C053 (end of travel limit switch) lights up.

This situation may occur at first installation or in case of actuator failure.

4.2. WARNING TO AVOID MECHANICAL DAMAGES TO THE ACTUATOR OR THE THROTTLE LEVER, DO NOT START THE CONTROL UNIT BEFORE HAVE COMPLETED ALL THE CALIBRATIONS.





5 ACTUATOR OPERATING MODES

5.1 MANUAL OPERATION % OR (α)

In this operating mode the accelerator opening is controlled directly from one of the potentiometers (C081 or C083) on the front panel (sheet 17) if is selected the internal control; from a remote demand potentiometer if is selected the external control; from a 0 ÷ 10 V d.c. voltage if is selected the computer control.

To operate from the front panel: set selector C077 (sheet 17) in position % INT. (fully clockwise); check green led C071 (%) is lit.

- . Select with the lever C082 the required potentiometer (C081 coarse regulation, lever upward, C083, lever downward, fine regulation).
- . Start the engine under test smoothly increasing the opening of the accelerator and after the engine has reached the operative temperature carry out the running tests.

To operate from remote demand potentiometer:

- . Connect a 10 K OHM potentiometer to the C5A connector of the control unit back panel. (see drawing 9-1331).
- . Set C077 to % ext. position.
To carry out the tests the way is the same above indicated.

To operate from computer:

- . Set the selector C077 in position comp.
- . Close the contact % of C1A connector (drawing 9-1331) (connect this contact between pins 3 and 4).
- . Give the demand signal 0 ÷ 10 V d.c. on pins 8 (-) and 9 (+) of C1A connector.

5.2 CONSTANT SPEED OPERATION n=K

To operate from the front panel:

- . Set C077 selector in position n=K INT.
- . Check green led C073 (n=K) is lit.
- . Select with the lever C082 the regulation potentiometer (C081 or C083).
- . Set with the potentiometer a speed.



The actuator will accelerate the engine until the set value is reached and after will correct automatically the opening in order to keep constant the speed also changing the torque.

- . In this operating mode can arise the need of changing the response time of the actuator to adjust it to the engine reaction in order to reach a good stability of the control.

To make this act with a small screwdriver on the trim pots 45, 46, 47 on the front panel (sheet 17).

- C045 PI $n=K$ is the proportional integral effect. It adjusts the stability, turning clockwise the stability is going to increase but the response gets slower.
- C046 D $n=K$ is the differential (derivative) effect. It adjusts the quickness, turning clockwise is going to increase the advance and so to make the response faster.
- C047 D.P. $n=K$ is differential effect of the actuator position. The effect is as much greater as faster is the movement of the actuator.

The adjustment of these three regulations is always a compromise between quickness, steady state stability and overshoot and the choice can be improved with the experience of the operator.

To operate from remote demand potentiometer:

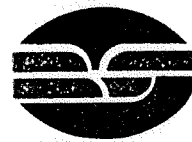
- . Connect a 10 K OHM potentiometer to C5A connector (see drawing 9-1331).
- . Set C077 to $n=K$ EXT position. To carry out the tests the way is the same above indicated.

To operate from computer:

- . Set the selector C077 in COMP. position.
- . Close the contact $n=K$ on C1A connector (connect this contact between pins 3 and 6).
- . Give the demand signal $0 \div 10$ V d.c. on pins 8 (-) and 9 (+) of C1A connector.

5.3 CONSTANT TORQUE OPERATION $M=K$

This operating mode is not possible with the SAT control unit alone; it is necessary a load cell, installed on the brake and connected to its signal amplifier (see our units MP 620 V or MP 630 S1) which can supply a torque signal $0 \div 10$ V d.c.



This signal has to be connected with an apposite cable either on C1A connector between pins 8 (-) and 10 (+) or on C3A connector between pins 2 (-) and 4 (+).

To operate from the front panel

- . Set C077 selector in position M=K INT.
- . Check green led C072 (M=K) is lit.
- . Select with the lever C082 the regulation potentiometer (C081 or C083) and set it on zero (completely counterclockwise).

- . Select the function n=K on the brake control unit and set a speed value of 1000 ÷ 1500 rpm.
- . Start the engine and warm it up giving a little load with the demand potentiometer of the actuator controller.
- . After the warm up, setting a torque value with the demand potentiometer the actuator will correct automatically the opening in order to keep constant the engine torque also changing the speed. Of course the demanded torque must not be higher than the maximum torque of the engine.
- . Also in this operating mode can arise the need of changing the response time of the actuator to adjust it to the reactions of the engine and brake in order to reach a good stability of the system.
To make this act with a small screwdriver on the trim pots 43, 44, 48 on the front panel (sheet 17).

C043 PI M=K is the proportional integral effect.

C048 D M=K is the differential effect.

C044 DP M=K is the differential effect of position.

The way of operation is the same above described for constant speed operation. In addition in this operating mode there is the possibility to change the filtering of the torque signal making it less or more fast according to need. To make this see the instruction manual of the load cell amplifier used (MP 620 V or MP 630 S1).

To operate from remote demand:

- . Connect a 10 K OHM potentiometer to C5A connector (see drawing 9-1331).
- . Set C077 to M=K EXT position.

To carry out the tests the way is the same indicated above.



To operate from computer:

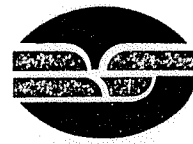
- . Set C077 in position COMP.
- . Close the contact M=K on C1A connector. (connect this contact between pins 3 and 5).
- . Give the demand signal $0 \div 10$ V. d.c. on pins 8 (-) and 9 (+) of C1A connector.

5.4 INPUTS, OUTPUTS, CONTROLS AND LED SIGNALINGS

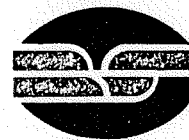
5.5 FRONT PANEL

With reference to the sheet 17 from left to right:

- C 041 : Green led "AL.OK.": when lit indicates the correct presence of all the internal stabilized supplies.
- C042 : Green led "BL.AZ": when lit indicates the control unit is on and the presence of all internal enabling signals.
- C048 : Differential effect in constant torque automatic control mode (M=K) (speeds up the response to dynamic variations).
- C043 : Proportional integral effect in constant torque operating mode (M=K) (stability).
- C045 : Proportional integral effect in constant speed operating mode (n=K) (stability).
- C046 : Differential effect in constant speed automatic control mode (n=K) (speeds up the response to dynamic variations).
- C051 : Red led available for indication of water pressure lack (e.g. on the brake or in the cooling circuit of an engine if duly connected to a pressure switch).
- C052 : Red led available for indication of water overtemperature (same considerations as for previous point C051).
- C053 : Red led indicating that the end of travel limit switch has been activated.
- C044 : Differential effect of position in constant torque operating mode (M=K).
- C047 : Differential effect of position in constant speed operating mode (n=K).



- C054 : Red led indicating breakdown on the power card or troubles with the feedback cable.
- C055 : Red led indicating engine overspeed or pick-up cable missing or stripped.
- C056 : Yellow led indicating min. or max. position. It lights up when the accelerator lever of the engine under test reaches one of the two end of stroke. It indicates the abnormal current absorption of the actuator motor under effort. It does not stay permanently lit against the destruction of the electric motor.
- C057 : Yellow led "ON" : when lit indicates that start button has been pushed and the control unit is in operating state.
- C058 : Led bar graph indicating the accelerator opening percentage.
- C059 : "RESET" and "LAMP" test pushbutton.
It does not reset the alarm condition if the trouble is still present. It is used to check the correct led operation.
- C064 : "STOP" pushbutton: when pressed puts the unit in a stand-by condition without control of the actuator.
- C065 : "START" pushbutton: when pushed, if there is no alarm on, puts the unit in operating state and lights up "ON" yellow led C057.
- C061 : Trimpot for minimum position adjustment. It adjusts the minimum accelerator opening required for the test engine.
- C062 : Trimpot for the maximum position adjustment. It adjusts the maximum accelerator opening required for the test engine.
- C063 : Trimpot for setting the trip level of a speed threshold relay. The contacts of this relay are available on C1A connector. If duly set this relay can detect the stop of the engine under test.
- C071 : Green led indicating the selection of the operating mode % (percentage).
- C072 : Green led indicating the selection of the operating mode M=K.
- C073 : Green led indicating the selection of the operating mode n=K.



- C074 : Hour-counter, trips every six minutes and it operates with test engine running.
- C075 : Hold pushbutton: when pushed blocks the accelerator in the actual position; to be used for example for changing operating mode with the test engine running.
- C076 : 10 turns potentiometer to set the overspeed alarm trip value.
- C077 : Operating modes rotary switch selector. Used to select the operating mode (% , M=K, n=K) and the control place (front panel, remote demand or computer).
- C081 : Coarse regulation potentiometer.
- C083 : Fine regulation potentiometer.
- C082 : Switch lever to select regulation potentiometer.

5.6 EMERGENCY AND SAFETY CONNECTIONS

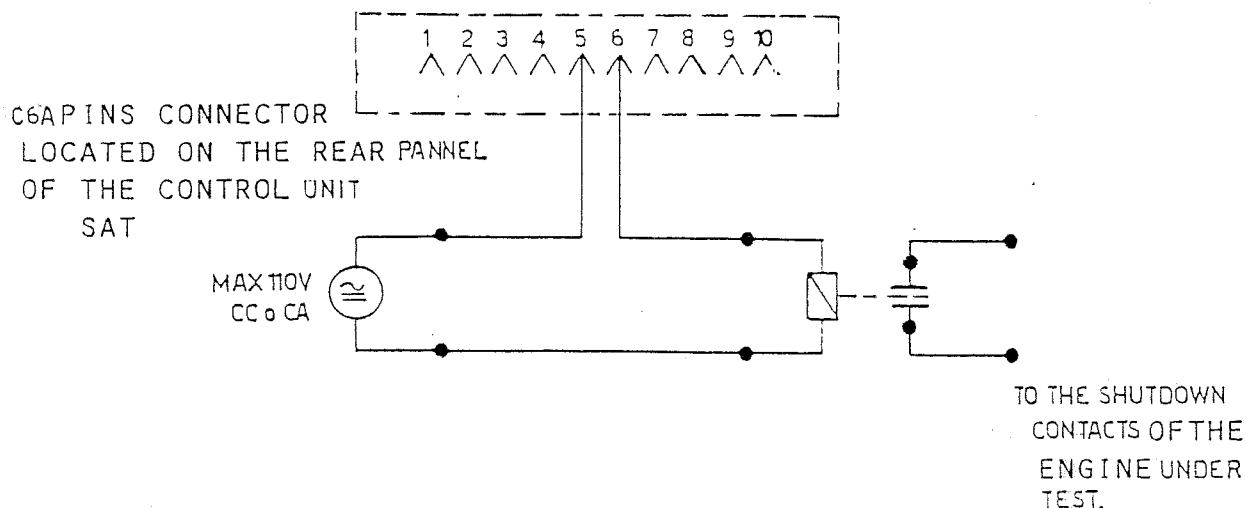
On pins 5,6,7, of C6A connector there are the potential free contacts C, NO, NC, of the safety relay (see electrical wiring diagram 9-1331).

The contact C-NO closes as soon as the C065 button ("START") is pushed (unit in operating state) and opens as soon as the unit goes in stand-by state pressing C064 button ("STOP") or in consequence of the trip of one of the two alarms C053 (limit switch) or C054 (control unit shut down).

To stop the engine under test the safety relay has to be connected to a power relay type Omron MM2P with socket 8PFA or similar.

The power relay Omron is not included in the supply and can be supplied on request.

The connections are at customer' care.



On pins 8,9,10 of C6A connector are available additional external alarms (lack of water pressure or water overtemperature). It is necessary to fit, on the water circuit, pressure and temperature switches and to connect the normally closed contacts. If either contact opens the respective led on the unit front panel lights up and the actuator goes immediately in the idle position and stays until the reset of the alarm condition.

If no external alarm probe is connected shunt together the terminals 8,9 and 10.

Beware: the overspeed alarm (even also the pick-up cable stripping) causes the return of the accelerator to the idle position until the reset given by the operator.

5.7 FEEDBACK ALARM

On the connector C2A are wired the signals of position (potentiometer), actuator speed (tacho generator) and the safety microswitch (cable drawing 9-1325). In case this cable is missing or faulty the control unit stays in an alarm condition with the red led C054 (control unit shut down) on, and does not start.

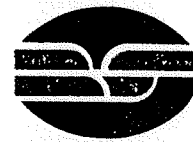


6 FAULT FINDING

FAULT	POSSIBLE CAUSES	CORRECTIVE ACTION
Switching on the equipment no indication is lit Drawing 9-1331	. Mains supply failure	
Green led "Al.OK" off. Drawing 9-1331	. Failure of +/- 12 V or + 10 VOLT . Mains supply undervoltage	. Card failure replace the control unit . Check the mains supply
The control unit does not start Drawing 9-1331	. Alarm trip	. Remove the alarm cause
The D.C. motor does not move Drawing 9-1331 Drawing 4419-74	. Mode selection or demand incorrect . D.C. motor not supplied	. Check the operating mode selected and/or the voltage reference To facilitate the test the operating mode % int. . Check the d.c. motor wiring.
Enclosure A	. D.C. motor damaged . The control unit is in Stand-by	. Check the d.c. motor. . Check that microswitch (20) is not activated



FAULT	POSSIBLE CAUSES	CORRECTIVE ACTION
In the operating mode n=K the engine speed is not controlled	. The speed signal is not detected	. Check the pick-up operation and its correct installation.
In the operating mode M=K, the engine torque is not controlled	. The torque signal is not read by the control unit	. Check the wiring to C1A or C3A connector Ensure that the torque signal 0 ÷ + 10 V. D.C. reaches the circuits
Overspeed alarm (red led C055 on) also with engine stopped.	. Electric connection with pick-up interrupted	. Check the pick-up and its wiring.
C054 on (control unit shut down) although green led "AL.OK" is on and in addition the bar graph % is completely lit. Drawing 9-1331	. Electrical wiring of the potentiometer interrupted or this one is damaged	. Check the wiring, the correct insertion of C2A and the good operation of the potentiometer.
In the operating modes n=K and M=K engine huntings around the set value arise	. P.I.D. stability effects out of adjustment	. Take note of the actual positions of the trimpots and adjust: - C043, C044, C048 PID parameters in the mode M=K. - C045, C046, C047 PID parameters in the mode n=K.



FAULT	POSSIBLE CAUSES	CORRECTIVE ACTION
The D.C. motor controls the position but the movement is irregular, noisy and vibrating	<ul style="list-style-type: none">. Shieldings not connected or stripped.. Bad connection to ground. Connections with other control unit incorrect	<ul style="list-style-type: none">. Check pick-up and feedback cables and connectors.. Check if connection to ground is correct. Check carefully the wirings and the shields connections.



7.1 POTENTIOMETER MAINTENANCE
=====

Instructions for the substitution of the potentiometer (Pos. 25) on the mechanical actuator (Drawing 4419-74).

In case it is necessary to replace the position feedback potentiometer follow the indication listed below.

- 1) With the control unit switched off remove the potentiometer protection (22) unscrewing the screws (20).
- 2) Check, with reference to the drawing 9-1345, that no wire is interrupted.
- 3) Remove the cam (27) from the spindle of the potentiometer unscrewing the locking screws (26).
- 4) Unscrew the screws (30) and remove the safety microswitch with its support (31).
- 5) Turn with the key the d.c. motor shaft until the locking screw of the elastic joint (19) is accessible from the opening.
Unloose this screw on the potentiometer spindle side.
- 6) Unscrew the three screws (24) which fix the potentiometer to the actuator and remove the three clamps (23).
- 7) At this point the potentiometer is free and can be removed.
- 8) Put on the new potentiometer inserting the spindle in the elastic joint (19) and fasten the screw (18)
- 9) Fix the three clamps (23) with the screws (24) taking care that the terminals are in the upper side.
- 10) Fasten the three screws (24)
- 11) At this point make the position calibration; using the key turn the electric motor until the rod (47) reaches the mechanic end of stroke FC1.
- 12) Still with the key come back of about 9 mm in the position FC2.
- 13) Take a digital voltmeter and connect the negative test lead to the terminal (1) and the positive lead to the terminal (2) of the potentiometer.
- 14) Switch on the control unit SAT.
- 15) Make sure that the min. pos. adj. trimmer (C061 sheet 17) is in the minimum position (counterclockwise).
- 16) Do not start the control unit
- 17) Turn slowly the potentiometer (25) toward left or right without move the gear bar, the electric motor and the potentiometer spindle, until...
- 18) You will read on the voltmeter a d.c. voltage of 0,25 Volt.
- 19) The calibration is completed; you have calibrated the electronic minimum, corresponding to the mechanic minimum position, for the optimal stroke adjustment.



- 20) Ensure that the cam be very close to the safety microswitch (28) but does not act on it.
- 21) Make again the calibrations as for the first installation.

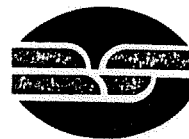
POTENTIOMETER (17) DATA:

Spectrol 208 Servo 1 KOHM,
Single turn.
2 Shafts.
Tolerance + 10%.
Linearity 0.3%.

MICROSWITCH (20) DATA:

Code 831410+Lever 55A5
Crouzet

N.B. After dismounting it is possible to open the potentiometer Spectrol 208 and to check if the resistive layer or the terminals are damaged. In this case the replacement is necessary.
The microswitch has a normally closed contact which opens when the lever acts on the switch signalling the blocking of the actuator in minimum or in maximum mechanical end of stroke.



7.2 ELECTRIC MOTOR MAINTENANCE
=====

Instructions for the replacement of the d.c. motor MO 600 with tacho generator on the actuator (Drawing 4419-74).

In case it is necessary to replace the d.c. motor with tacho operate according to the following instructions:

- 1) With control unit switched off remove the cover (33) and the potentiometer support (21).
- 2) Unscrew the screws Pos. (9) and (40).
- 3) Disconnect the connector A from A1 (Drawing 9-1346/47/48) and extract the contacts from the body.
- 4) Extract the cables from the respective bushes.
- 5) Remove the motor.
- 6) Look for the reason of the motor malfunction; remember do not open the motor, the opening will cause the destruction of the magnetic field. Check if there are binding of the rotor movement (warped commutator) or tacho generator failure (no speed feedback signal); in both cases it is necessary to replace the motor.
- 7) Put on the new motor.
- 8) Make again the position calibration of the actuator, since removing the motor the previous calibration has been lost.

MAVILOR M0600 WITH TACHO GENERATOR
=====

N.B. Do not open the motor and separate the rotor from the housing. This would cause the demagnetisation of the permanent magnets fitted on the stator. Therefore it is possible only to check the wear of the brushes and to confront the data which is possible to measure on the motor and the tacho with those listed in enclosure A (Sheet 31).



ENCLOSURE A
TECHNICAL DATA OF D.C MOTOR MAVILOR M0600 WITH TACHO GENERATOR
=====

CHARACTERISTICS	UNITS	M0 600
Rated speed	rpm	3000
Rated voltage $\pm 5\%$	Volt DC	88
Rated current	A	9,5
Rated power output	Watt	700
Efficiency	%	84
Rated torque	cmN	223
Stall current	A	8,5
Maximum torque	cmN	1500
Maximum speed	rpm	5000
Torque constant	cmN/A	24,5
Terminal resistance (25 C)	Ω	0,93
Speed torque constant	rpm/cmN	1,45
Inductance	μ H	120
F.C.E.M. + 5%	V/1000 rpm	26,1
Mechanical time constant	msec	10
Thermal time constant		
rotor housing	S	250
Thermal resistance	$^{\circ}$ C/W	0,8
rotor housing		
Radial load at mid lenght of the shaft	Kp	25
Axial load	Kp	20
Weight	Kp	7
Friction torque	cmN ₂	5,5
Moment of inertia	gcm ²	6800
CHARACTERISTICS	UNITS	TACHO ROLIVAM D23-25
Voltage constant $\pm 5\%$	V/1000 rpm	10
Ripple at 1000 rpm	%	1,2
Linearity at 6000 rpm	%	0,1
Reversibility error	%	0,12
Temperature coefficient	% / $^{\circ}$ C	0,02
Moment of inertia	g.cm ²	240
Resistance	Ω	90
Inductance	mH	25
Rated current	mA	4
Maximum current	mA	17
Maximum speed	rpm	8000
Brushes:		
Quantity	N	4
Quality	AG-35	
Dimensions	mm	3,5x4,5x9,5
Life expectance	rpm	1,1x10 ⁹
Weight:		
Rotor	Kp	0,127
Housing	Kp	0,168
Number of poles	N	4

SPARE PARTS LIST



Borgini & Savarini

THROTTLE ACTUATOR AT 4419

SHEET NO. 32

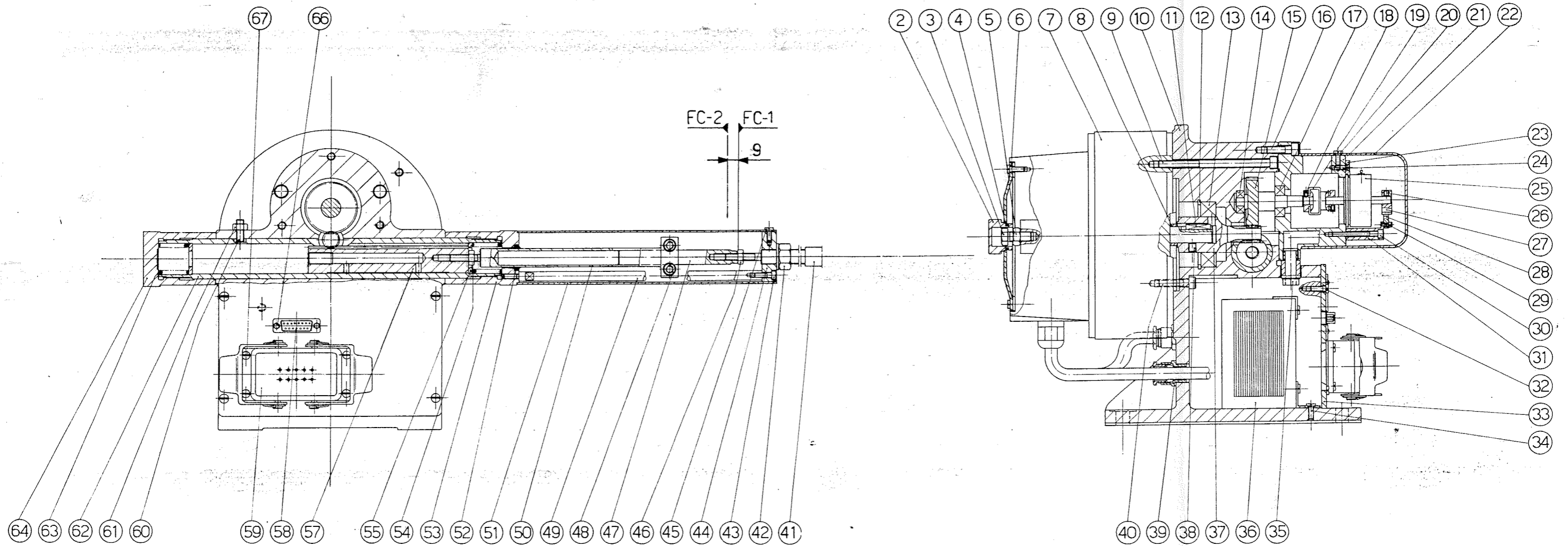
Please specify the serial number-position and quantity in case of spare parts requirements.

OVERALL DIMENSION DRAWING				4419/74		* Recommended spare parts.			
POS.	SERIAL NO.	DESCRIPTION	QTY	*	POS.	SERIAL NO.	DESCRIPTION	QTY	*
1					48	3067016	M6x16 Screw UNI 5931	2	
2	4419/100	Sealing cap	1		49	4419/83	Tie rod	2	
3	3066013	M8x20 Screw UNI5739	1		50	4419/81	Rod guide	1	
4	3064003	OR 121 Ring	1		51	4419/84	Protection	1	
5	3021005	M8 Nut UNI5588-65	1		52	3102003	RM 1622 Ring	1	
6	4419/89	Cover	1		53	4419/78	Ring Nut	1	
7	4419/99	D.C. Motor M0600 with tacho	1	*	54	3021004	M6 Nut	1	
8		M0 Spacer	1		55	4419/91	Washer	2	
9	3067071	M6x80 Screw UNI5931	2		56	4205	Plate	1	
10	4419/75	Actuator Body	1		57	4419/96	Gear Bar	1	*
11		Sunk Key	1		58		15 Pole Male harting connector	1	
12	3051008	D 55 Ring UNI 3654	1		59		10 Pole Male ILME Connector	1	
13	3011006	6002-2RS Bearing	1		60	3087001	M6x20 Screw UNI S925	1	
14	3011066	607 2RSR Bearing	1		61	3021004	M6 Nut	1	
15	4419/52	Toothed pivot	1	*	62	4419/27	Pipe	1	
16	3067017	M6x20 Screw UNI 5931	3		63	4419/88	Spring	2	
17	3011067	6000-2RSR Bearing	1		64	4419/79	Ring Nut	1	
18	3074015	M3x4 Screw UNI 5927	2		65	3044006	035x65 Rivet UNI5241	1	
19	33061621	Elastic joint	1		66		Harting connector Screw	1	
20	3068004	M4x8 Screw UNI6107-67	3		67	3068004	M4x8 Screw UNI6107	4	
21	4419/76	Potentiometer support	1						
22	4419/77	Potentiometer protect.	1						
23	4419/40	Clamp	3						
24	3073002	M5x12 Screw UNI6109-67	3						
25	4026003	Potentiometer	1	*					
26	3074009	M4x5 Screw UNI 5927	2						
27	4419/441	Cam	1						
28	4019012	Microswitch	1	*					
29	3068011	M2x10 Screw UNI6107-67	2						
30	3067004	M4x35 Screw UNI 5931	2						
31	4419/451	Support	1						
32	3068005	M4x12 Screw UNI 5931	4						
33	4419/85	Cover	1						
34	3068004	M4x8 Screw UNI6107-67	2						
35	4419/86	Pipe fitting	1						
36	4419/93	Inductor	1						
37	4419/50	Pinion	1	*					
38	3075003	M6x10 Screw UNI 5923	1						
39	4027016	Ø 3/8 Gas Cable bush	2						
40	3067017	M6x20 Screw UNI 5931	2						
41	3006018	6011 Cable L1500-C125	1						
42	3006014	IK 4 Nut	3						
43	3067074	M4x14 Screw UNI 5931	2						
44	4419/82	Disk for cable fastening	1						
45	3068004	M4x8 Screw UNI 5931	2						
46	3021004	M6 Nut	1						
47	4419/80	Cable rod	1						



9 INDEX OF ELECTRIC DIAGRAMS
=====

<u>DRAWING</u>	<u>DESCRIPTION</u>
9-1325	Feedback cable with tacho.
9-1326	Pick-up cable.
9-1327	Potentiometer and microswitch connection cable.
9-1328	Shunt for enabling manual operation.
9-1331	General wiring diagram.
9-1345	Potentiometer and microswitch fast coupling wiring.
9-1346	Internal wiring AT4419 - Motor with fast coupling connectors.
9-1347	
9-1348	
9-1349	Power cable.



Specifiche tecniche soggette a cambiamenti senza preavviso.
 Technical specification subject to change without notice

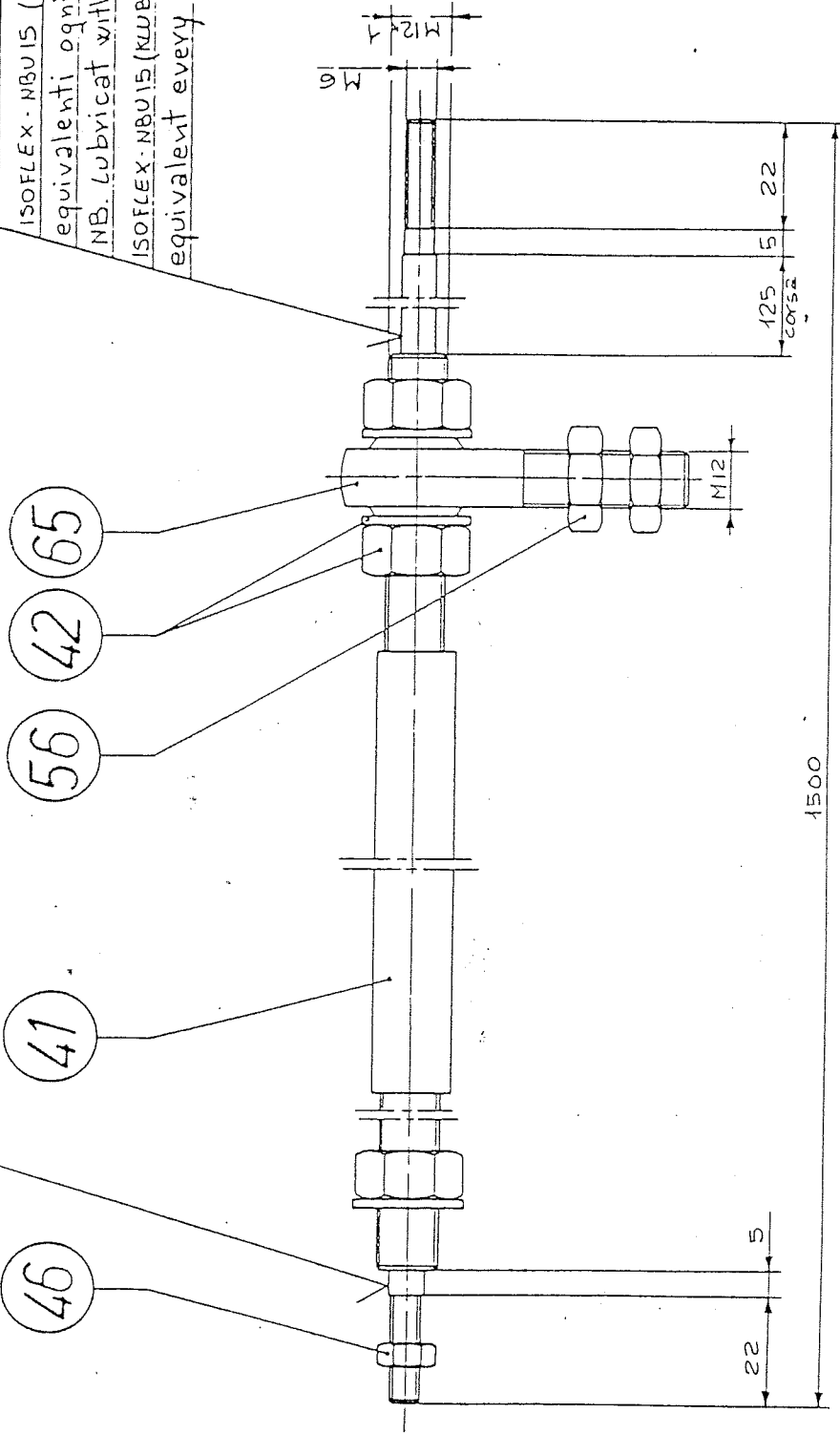


Borgini & Savari

DISEGNO D'INSIEME ATTUATORE MECCANICO AT-4419
 MECHANICAL ACTUATOR DRAWING AT 4419

DIS. N.º 4419/74
 DRAW.N.º 4419/74

NB. Lubrificare con grasso
ISOFLEX-MBU15 (KUBER) o
equivalenti ogni 50 ore
NB. Lubricat with grease
ISOFLEX-MBU15 (KUBER) or
equivalent every 50 hours

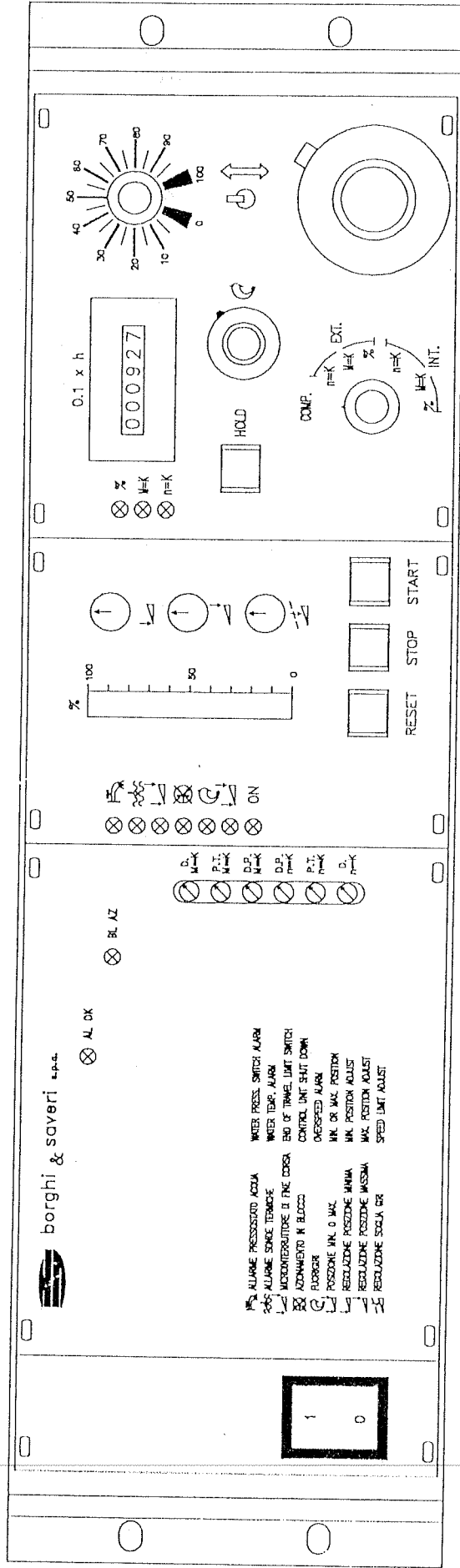


vedi distinta 6.005.027

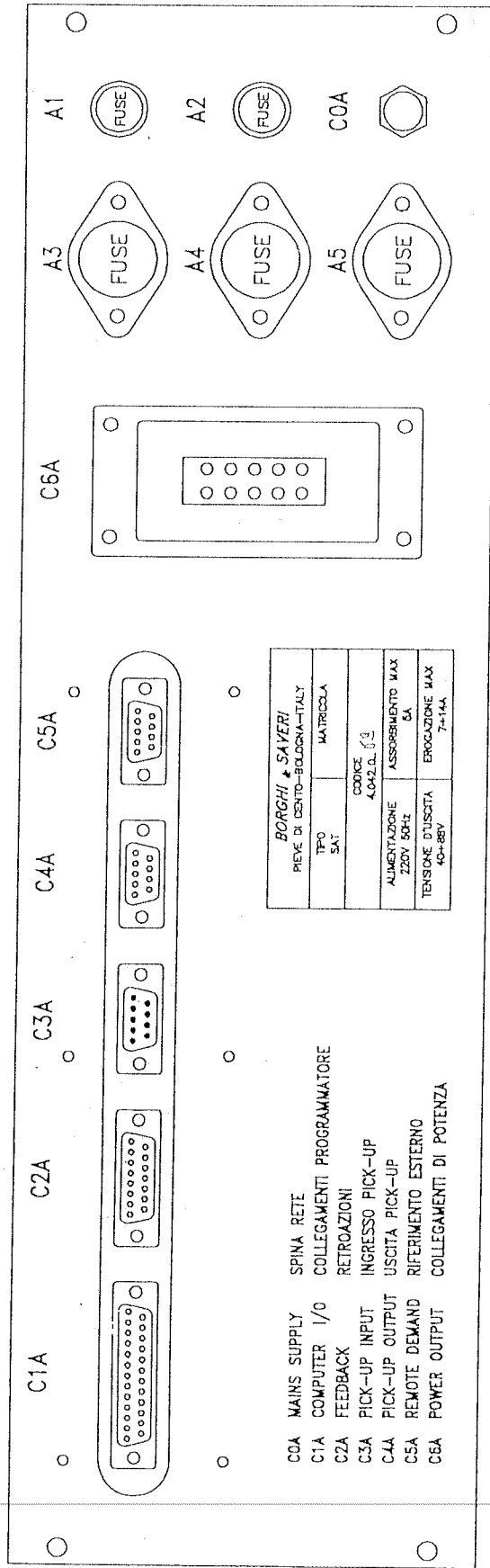
65	Snodo sferico terminale maschio M12	1	3.055.002
56	Dado esag. basso M12	2	3.021.015
46	Dado esag. norm. M6 zincato	1	3.021.004
42	Dado 1x4 + rondella TREEFFE	3	3.006.014
41	Cavo 6011 L=1500 corsa 125 TREEFFE	1	3.006.018
Pos.	Descrizione	Quantità	Codice

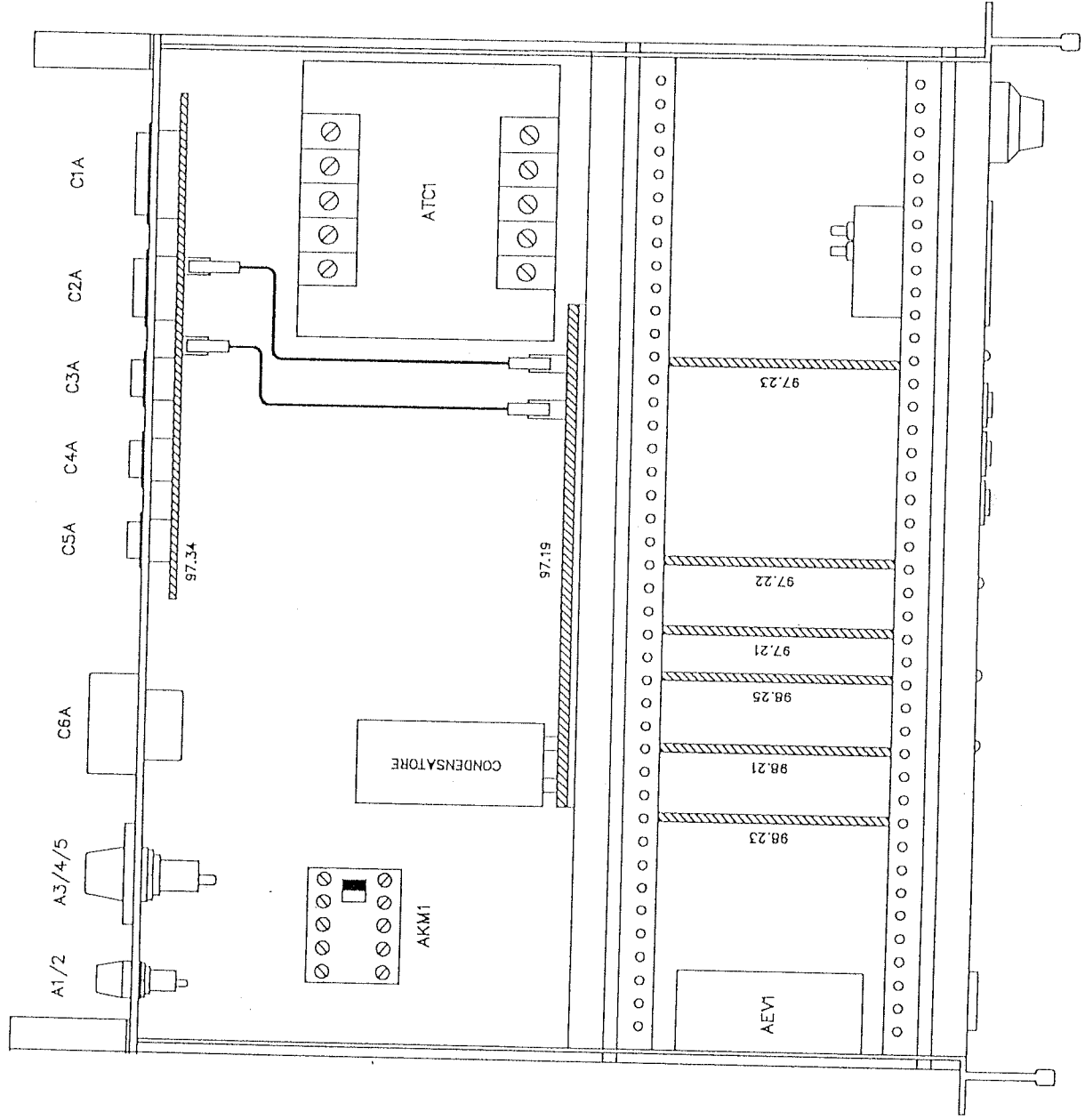
Il presente disegno è di natura esclusiva proprietà. Senza il nostro consenso non può essere copiato, ristampato o altro modo di utilizzo. Il costruttore non è responsabile delle disposizioni di legge vigenti in materia.


Gruppo	Dis.	Spazio	Trattamento	Modello N	Peso unit. Kg	Insieme gener. dis N	Disegn.	Verif.	Aut.	Disegn.	Verif.
M. Pizzi		Materiale		Comunicazione		Insieme part. dis N		Insieme part. dis N		P. 07	
OFF. MECCANICA BORGHINI & SAVERI PIEVE DI CISTO		Scale 1:1		Data 07-06-92		Sostituisce il		Arch.		DIS. N. 4419-97	
Oggetto <u>Comando Asservito=OR2</u>		Gruppo <u>AT-4419 (serie 90)</u>		Particolare <u>Premontaggio cavo 6011 TREEFFE</u>		Sostituisce il		Arch.		DIS. N. 4419-97	
Dis. <u>GR</u>		Scale <u>1:1</u>		Data <u>07-06-92</u>		Sostituisce il		Arch.		DIS. N. 4419-97	
Lucid.		Sigla		Sostituto del		Arch.		DIS. N. 4419-97		DIS. N. 4419-97	



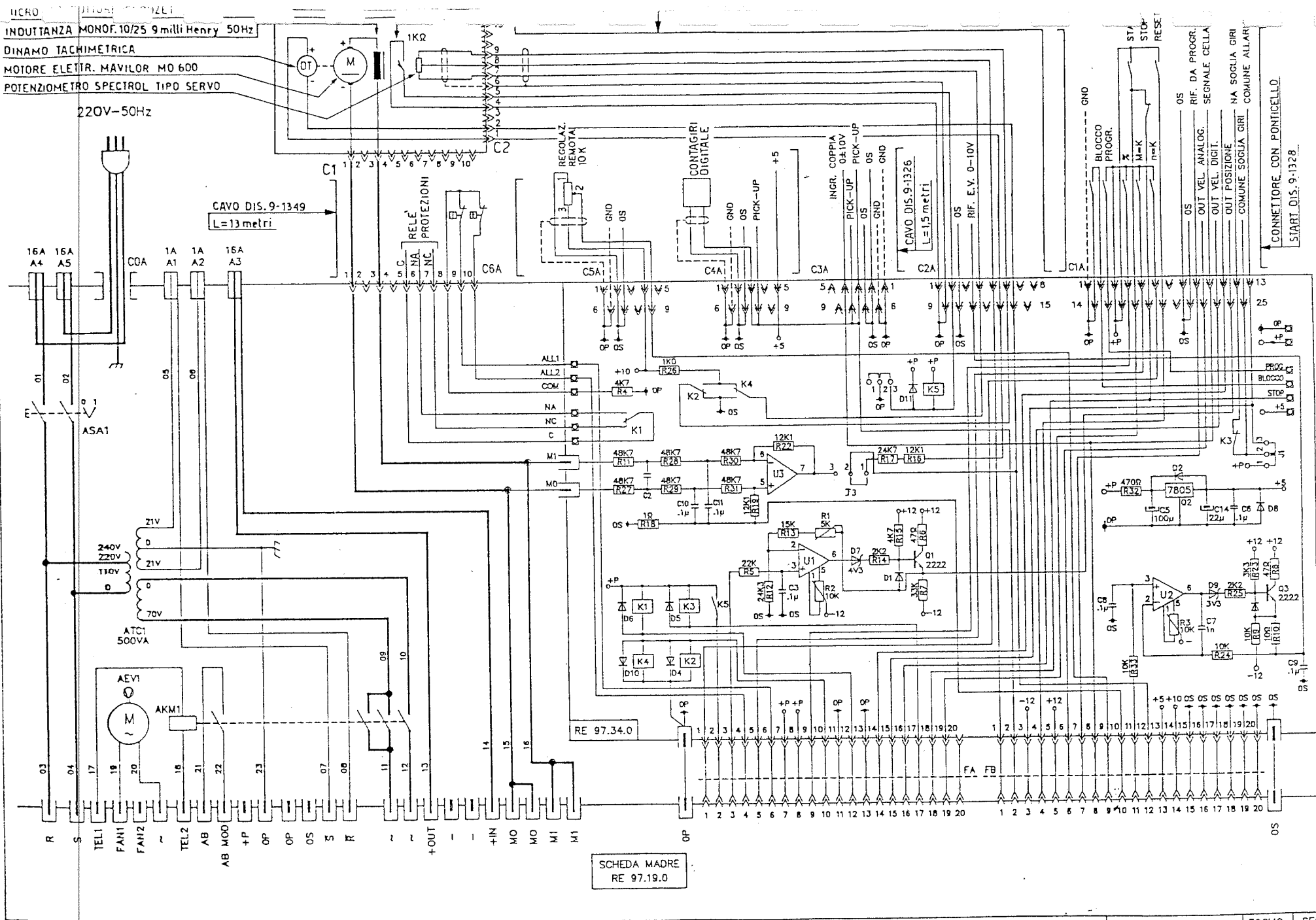
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	14-5-1991	WALTER			FRONTALE ANTERIORE PER SAT	9-1086	01	



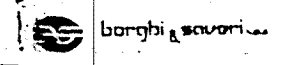


 Borgini & Saverio s.p.a.	DATA 14-5-1991	DISEGNATO WALTER	VISTO U. T.	MODIFICHE	TITOLO DISEGNO TOPOGRAFICO PER SAT	DISEGNO 9-1394	FOGLIO 01	SEGUE
	PROPRIETA' RISERVATA QUESTO DISEGNO E' DI PROPRIETA' DELLA CITTA' B&S s.p.a. E NON PUO' ESSERE FORNITO O RIVELATO SENZA AUTORIZZAZIONE SCRITTA							

PROPRIETA' RISERVATA QUESTO DISEGNO E' DI PROPRIETA' DELLA DITTA B & S SPAE NON PUO' ESSERE FORNITO O DIVULGATO SENZA AUTORIZZAZIONE SCRITTA



SCHEDA MADRE
RE 97.19.0



DATA	DISEGNATO	VISTO U. T.	MODIFICHE
10-12-1990	WALTER		ULTIMO N. 23

TITOLO SCHEMA ELETTRICO SAT

DISEGNO	FOGLIO	SEGUE
9-1331		