Electro Hydraulic Servo - Positioning valve NG6 with Electrical Retransmission

Drawings:	Sectional	4 ST – 24 – 12
	Operation diagram	4 RS – 24 – 1a
	Upper part of servo-valve	4 MT – 24 – 4

1. Technical data

Max. oil flow:	at 15% from signal end value
Vibration test:	on 3 planes at 25 Hz and 1 mm over 3 minutes. Max. acceleration = 2,5 gn
Sensitivity:	≤ 0,2% of full scale of signal
Hysteresis:	≤ 0,4% of positioning range
Temperature effect:	≤ 0,5% of ambient temperature
Input signal:	printed direct current
Retransmission signal:	0-20 mA or 4-20 mA
Protection class:	IP 00 or (Ex) s G5
Oil filter:	10µm necessary
Max. operation pressure:	160 bar

2. Method of operation

The operation of the servo-valve can be divided in two parts:

- the transformation of the electro -hydraulic signal with the preliminary hydraulic amplifying stage, assembled in full bridge connection.
- the hydraulic power stage.

The permanent magnet system (19/2) generates between the connection terminals a force field which actuates the armature (19/5).
The armature is balanced by two retaining springs (19/1) in such a way that it remains in a stable middle position between the connection terminals. The force field of the permanent magnet is superposed by two other force fields fitted in opposition and generated by the control coil (19/6) and the retransmission coil (19/6a); these two force fields are symmetrically positioned between the connection terminals.

When the input signal passes through the coil, the force field generated by the control coil and the permanent magnet are added up. The force field of the magnet is displaced and the armature, held by its springs, follows. Consequently, the control vane (19/21) connected to the armature is also actuated and covers to an unequal extent the two nozzles (19/20) of the control vane system. This system is supplied with oil under pressure. The oil flow is divided in two and passes through two restrictors (19/15) and is admitted to the nozzles (19/20). The displacement of the armature produces pressure differences between nozzle/Control vane causing a differential pressure operating against the end faces of the valve piston (19/23).

The valve piston (19/23) – used as a force amplifier – is retained by two springs and placed hydraulically in the ZERO position by means of the adjusting screw (19/25) and when the input signal is turned off. When the differential pressure of the preliminary amplifying stage begins to operate against the end faces, the control piston is displaced, the oil flow is set free and admitted to respectively from the final control element.
The oil under pressure passing through the control piston is carried the double check valve fitted downstream of the servo valve. The oil pressure opens the cone valves (19/28) under the effect of the divided piston (19/29) so that the oil can flow to and from the final control element. The movement of the final control element (Operating cylinder) is converted into an electrical signal (retransmission signal – printed direct current) .This retransmission signal is connected to the retransmission coil (19/6a).As soon as the force of the retransmission coil compensates the force of the servo valve soil, the armature returns to its middle position between the connection terminals. The complete system is now replaced into its initial position and consequently, the movement of the final control element is discontinued.

The position of the operating cylinder is directly proportional to the input signal.

3. Instruction in case of failure

3.1 Oil failure

On failure of the oil pressure, the servo valve stops operating, i. e. the operating cylinder remains locked in its last control position.

3.2 Failure of input signal

On failure of input signal, the operating cylinder drives in the position corresponding to the input signal = “ 0 mA”.

3.3 Failure of the retransmission signal

On failure of retransmission signal, the operating cylinder drives in the limit position corresponding to the maximum input signal.

3.4 Failure of input signal and retransmission signal

On failure of both signals, during the pump is still running on, the armature is retained in its middle position! In theory, any movement of the final control element should stop., but in practice and due to a too slight covering of the control piston, the operating cylinders may drive slowly in one of the two limit position.

3.5 Failure of input signal and/or retransmission signal

Should the final control element be locked in position on failure of signals, the oil flow to the servo valve must be interrupted, thus closing the double check valve in the servo valve and so the final control element remains locked in its last position.
This measure can be realised by installing an electronic control system for the signals. In this case, use our control device for signals for signal scales without ZERO (e.g. 4 – 20 mA). This control device uses either an on-off switch which stops the motor of the pump, or better, a valve fitted in the oil pipe to stop the oil flow on failure of signal.
This vale must be fitted by the manufacturer if not included in the initial order.

4. Electrical connections

The connections for the input signal and the retransmission signal are realised on the electrical terminal board located in the electric distribution box. And in accordance with the connections diagram.

5. Maintenance of servo valve

The following components of the valve body can be disassembled without modifying the settings made in factory:

- Nozzle (19/20): loosen both screws (19/19)

Caution
Do not alter the clamping of bracket (19/18) by moving retaining screw (19/17).

- Restrictor (19/15) with threaded bolt (19/16)
- Control piston (19/23) – (Do not modify initial assembly direction).
  (Do not remove adjusting screw (19/25).

5.1 Checking and adjusting the middle position of control piston

Drawing: 4 ST – 24 – 12

The following equipment is necessary: 1 measuring flexible tubing with pressure gauge (this gauge is existing inside tool box for the types: SM)

5.1.1 During this procedure the actuator remains in operation. Loosen screw (19/19) and pull out the two nozzles (19/20) approx. 1 mm. Loosen Allen screw (19/26) till it is possible to turn adjusting screw (19/25) Now turn inwards or outwards this screw only to the very precise point where the final control element starts to drive in one of the two directions. Do not unscrew more than 2 turns approx. So as to maintain the sealing action of O-ring (19/27). Then, turn slowly adjusting screw (19/25) in the other direction until the direction of operation is reserved (approx. 1-4 to 1-2 turn). Turn again adjusting screw (19/25) in opposite direction until final control element stops in any position. Retighten allen screw (19/26) and screws (19/19).
If existing, close hydraulic reservoir.

5.1.2 Drawing 4 MT – 24 – 4; Unscrew protection caps from measurement points "A" and screw the flexible tube with the pressure gauge.

Start motor and place final control element in any position (approx. Middle position) in accordance with input signal. The pressure gauge indicates now the pressure exerted on the control vane. If the oil reaches its service temperature, the pressure should range from 6 to 8 bar. Check in the same way on the other side. In the event of uneven pressure (more than 2 bar difference) the middle position of the control piston should be readjusted.

5.2 Checking and adjusting the pressure control vane

Drawing: 4 ST – 24 – 12

Preliminary conditions:

1. Actuator in operation.
2. Final control element in this limit position which corresponds to nozzle to be checked.
3. Control current cut off.
4. Control piston middle position is checked.

5.2.1 Checking

Using thumb and forefinger, displace armature to the left until it reaches the stop (final control element drives in the corresponding limit position).

Caution!

Remove armature only in the longitudinal axis of the spring.
Check pressure on the right checking adapter. Now the pressure of the control vane should be inferior by approx. 10% of the pressure adjusted on the pressure switch. Same procedure for checking the pressure on the left control vane. Both pressure must be equal.

5.2.2 Adjustment

Loosen screw (19/17) in the right nozzle Using thumb and forefinger, displace armature carefully to the left until it reaches the stop. Keep it in position.

5.2.2.1 Pressure too low at the control vane

Screw the left stop inwards to the point where the Pressure decreases by approx. 2 bar; then screw the right nozzle inwards till the pressure on the pressure gauge, on the right side, remains stable to approx. 10% Below the pressure adjusted to the pressure limit switch

Example:

- Pressure at the pressure limit switch	40 bar
- Pressure required at the control vane	36 bar
- Real pressure at the control vane	35 bar
- Unscrew stop to the point of	33 bar
- Adjust nozzle to the point of	36 bar

5.2.2.2 Pressure too high at the control vane

Unscrew the control vane till the pressure remains stable approx. 2 bar below the required pressure. Then, screw the stop inwards till the pressure remains stable by approx. 10% below the pressure adjusted to pressure limit switch

Example:

- Pressure at the pressure limit switch 40 bar
- Pressure required at the control vane 36 bar
- Real pressure at the control vane 38 bar
- Unscrew stop to the point of 35 bar
- Adjust nozzle to the point of 36 bar

5.2.3 Tighten screw (19/17). Should the pressure change during this operation, repeat adjustment. Same procedure for adjustment of left nozzle.

6. Cleaning

Caution!
Before cleaning the servo valve, stop the motor-pump unit and close or drain hydraulic reservoir (if fitted).
Make cleaning operation on each oil changing

6.1 Disassembling control piston and sleeve

Disassemble control piston (19/23) for cleaning. Wash only carefully control piston (19/23): Do not alter assembly direction. Proceed to adjustment in conformity with 5.1

6.1.1 Disassembling with special tool "ZU 7"(This tool must be ordered separately)

Switch off motor unit

- For actuator fitted out with hydraulic reservoirs, closed the valve in the reservoir pipe or drain the reservoir using the drain cock.
- Unscrew the two flanged housings (19/24)
- Push out control piston (19/23). (Take notice of assembly direction).
- Fit special tool in valve sleeve (19/22), unscrew ring bolt and remove the sleeve turning slightly the tool to the right. (Take notice assembly direction).

6.1.2 Reassemble with special tool "ZU 7"

- Do not reverse assembly direction of the control piston in relation to the sleeve.
- Remove carefully control piston from sleeve.
- Place sleeve on the special tool and screw the sleeve slightly.
- Ensure that the 6 O-Rings (19/31) are in correct position. The external part of the sleeve should be carefully lubricated. Then, slide the sleeve into the housing, turning the tool slightly to the right till it reaches the stop

- After withdrawal of the special tool. Push the control piston into the sleeve (take notice of assembly direction).
- First, screw flanged housing (19/24) with spring washer and compression spring; replace spring plate (19/32), spring washer and compression spring, and then, screw the second flanged housing (19/24).
- Using adjusting screw (19/25), adjusted mechanical middle position of control piston (19/23)

Other adjustment in conformity with 5.1

6.2 Cleaning of restrictors

Loosen threaded bolts (19/16) with restrictor (19/15). Clean with compressed air.

6.3 Cleaning of restrictor filter

Before cleaning, switch off motor unit. Loosen the two threaded bolts (19/16) with the restrictors (19/15). Using a clean rod (∅6 to 7), push out the filter (19/14) from the restrictor. Dirt and other deposits may collect on the outside of the filter strainer. Wash out filter using rectified petrol or similar product.

7. Repair

7.1 Replacement of armature and / or coil

During disassembly take care not to reverse the polarity of permanent magnets (19/2). First, unhook retaining spring (19/1). Mark the magnet strap and then, remove magnet. Unscrew the two supports with terminals (19/01) and remove them to the left and to the right. Pull our coil (19/6) upwards. Unscrew and remove complete armature (19/5). Now unscrew nozzles (19/20) by approx. 1 mm. Place slackly the new armature. Them hand screw nozzles from the right and the left side towards the control vane (19/21) up to the point where the armature comes to a vertical position. Now screw the armature and unscrew the nozzles. After figment of coil (19/6), place supports (19/01) on casing and lock the magnet strap (19/2). Then, displace magnet yoke (19/01) with magnet strap (19/2) so that at the lower terminals Right and left, the distance is equal in relation to armature (!9/5). After this operation, screw the magnet yoke in casing. Hook spring and lock them using straps in copper wire.
For adjustment of middle position of control piston (19/23) and nozzles (19/20), proceed in conformity with 5.1

7.2 Replacement of valve sleeve (19/22)

Replacement of valve sleeve (19/22) and control piston (19/23) in conformity with 6.1

7.3 Replacement of retaining spring

Hook the two retaining springs (19/1) and lock them to the armature (19/5) using strips in copper wire. The control system is in operation. Input signal and retransmission signal are switched off. Displace the armature (19/5) manually in order to drive the final control element from the limit position. This operation should be done slowly and carefully. After the release of the armature, the final control element should remain in position. If this is not so, correct the middle position of the armature turning coarse adjustment (19/3) or fine adjustment (19/4) till final control element remains locked in position.
For sufficient pre-stressing of retaining springs, dimension “a” should be off approx. 11mm on both sides of the permanent magnet.

8 Instruction for repair

Before making any repair to the servo valve, check first the following points:

a) Are the control signal and retransmission signal ready to operate?

b) Are all electrical connections faultless?

c) Is there any particle of iron or other deposit between a terminal and the armature?

d) Is the pressure filter dirty?

e) Are all shut-off cocks in open position?

Always close the tool casing and the electrical distribution casing. These casings should be opened only during checking and repairs. To open or closed the distribution casing, use a 7mm square spanner. The tool casing can be opened and closed with a double-bit key.

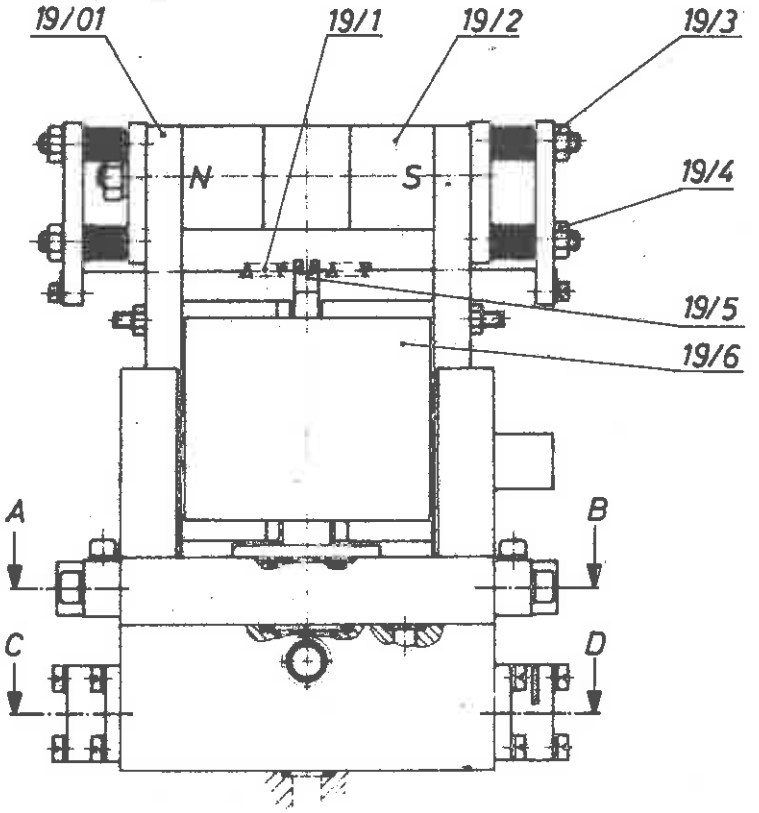
8.1 Fault diagnosis

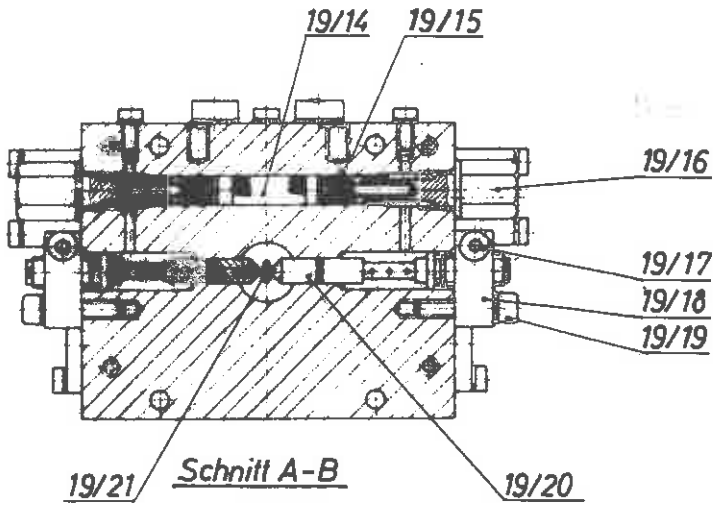
8.1.1 Type of malfunction	Probable cause	Check and repair
The piston in the operating cylinder has travelled to one limit position and remains stationary	Broken retaining spring (19/1)	Replace spring as described under 7.3
	One of the restrictor is blocked	Switch off motor unit. Unscrew threaded bolt (19/16) with restrictor (19/15). Clean with compressed air. Remove dust particles With a thin wire.
	Faulty connection to servo valve	Check piping and all connections.
	Dirt particles between vane(19/21) and nozzle (19/20)	Loosen both screw (19/19) and withdraw nozzle (19/15) of approx. 1 mm. The particles will be carried to the sump by the oil flow. Do not remove locking screw(19/17) fitted on bracket (19/18)
	CAUTION!	**Do not** switch off the motor unit during this operation. Re-tighten screws (19/19)!!
	Faulty oil line to operating cylinder	Re-tighten connections. Check all oil lines

8.1.2 Type of malfunction	Probable cause	Check and repair
Positioning time of servo valve is excessive and /or positions range displaced	One of the restrictor(19/5) is dirty or half blocked	Clean restrictor as described under 6.2

8.1.3	**Type of malfunction**	**Probable cause**	**Check and repair**
	Stroke of operating cylinder displaced	Wide variations in ambient temperature as e.g. between summer and winter	Displacement cannot exceed 3%. Correct it with adjusting screw(fine adjustment – 19/3)
		Iron particles on the terminals	Clean terminals, armature and magnet.
		Faulty armature diaphragm (19/5)	See under 7.1

8.1.4	**Type of malfunction**	**Probable cause**	**Check and repair**
	Oil pressure correct, but servo valve inoperative	Pressure filter is dirty or blocked	Close bypass cock up stream of filter. Replace filter element. Do not stop control system during this operation, but close bypass cock for a short time only.
		Faulty pressure regulator(if fitted)	Check and if necessary adjust, in conformity with : BE-72-24/11 pos.3,2





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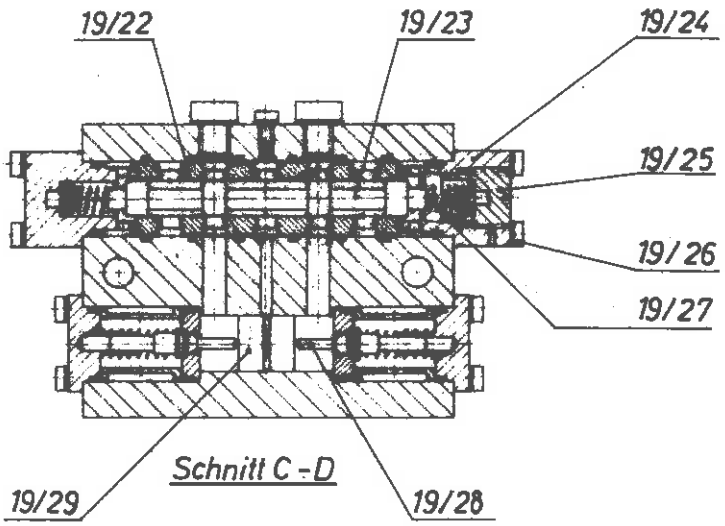

Schnitt C-D

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REINEKE	Gezeichnet: 15.4.77 Gr.	Electro-hydraulic Servo-valve type ESS with double coil U12/60	Ausgabedatum:
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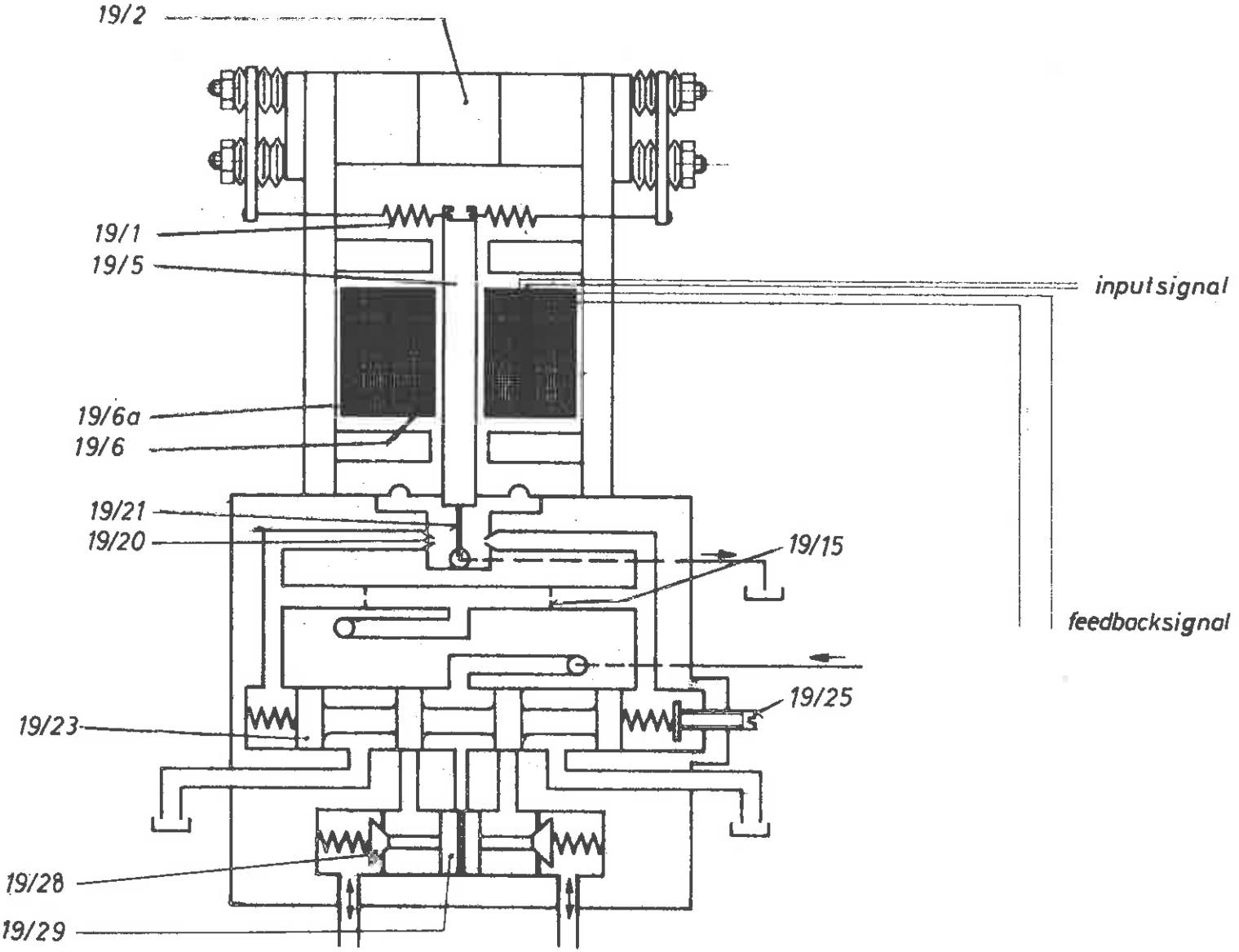
	Funktion geprüft:		
	Ersatz für:		
	Ersetzt durch:		

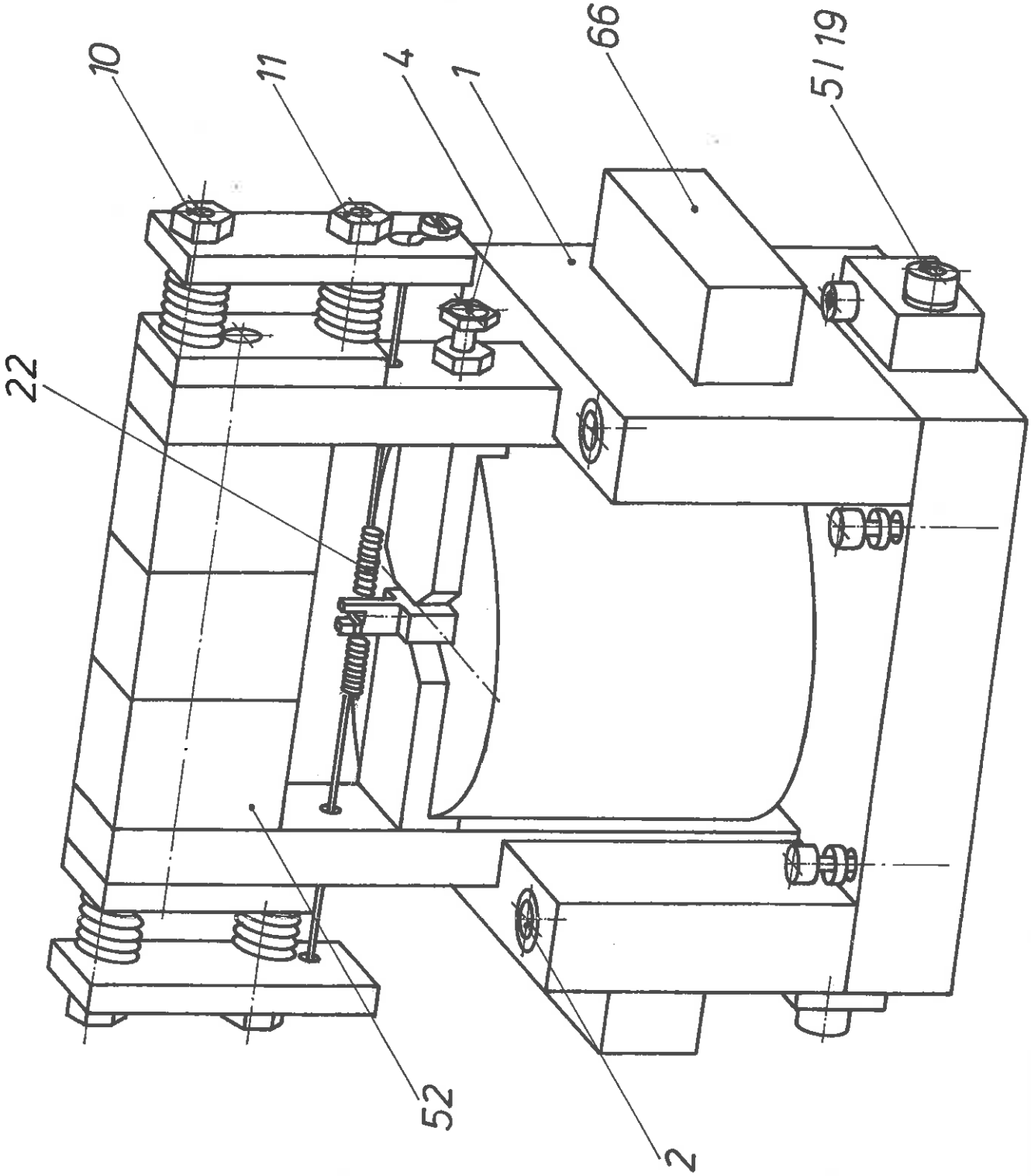


Gezeichnet: 12.11.76 Ja
Geprüft: Ie

Electro.hydraulic controller Type U12

Ausgabedatum:

4 RS – 24 – 1 a



REINECKE	Gezeichnet: 13.8.81 Pe Geprüft: Pe Ersatz für: Ersetzt durch:	Servoventil-Oberteil Servo-Valve	Ausgabedatum: 4MT-24-4

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