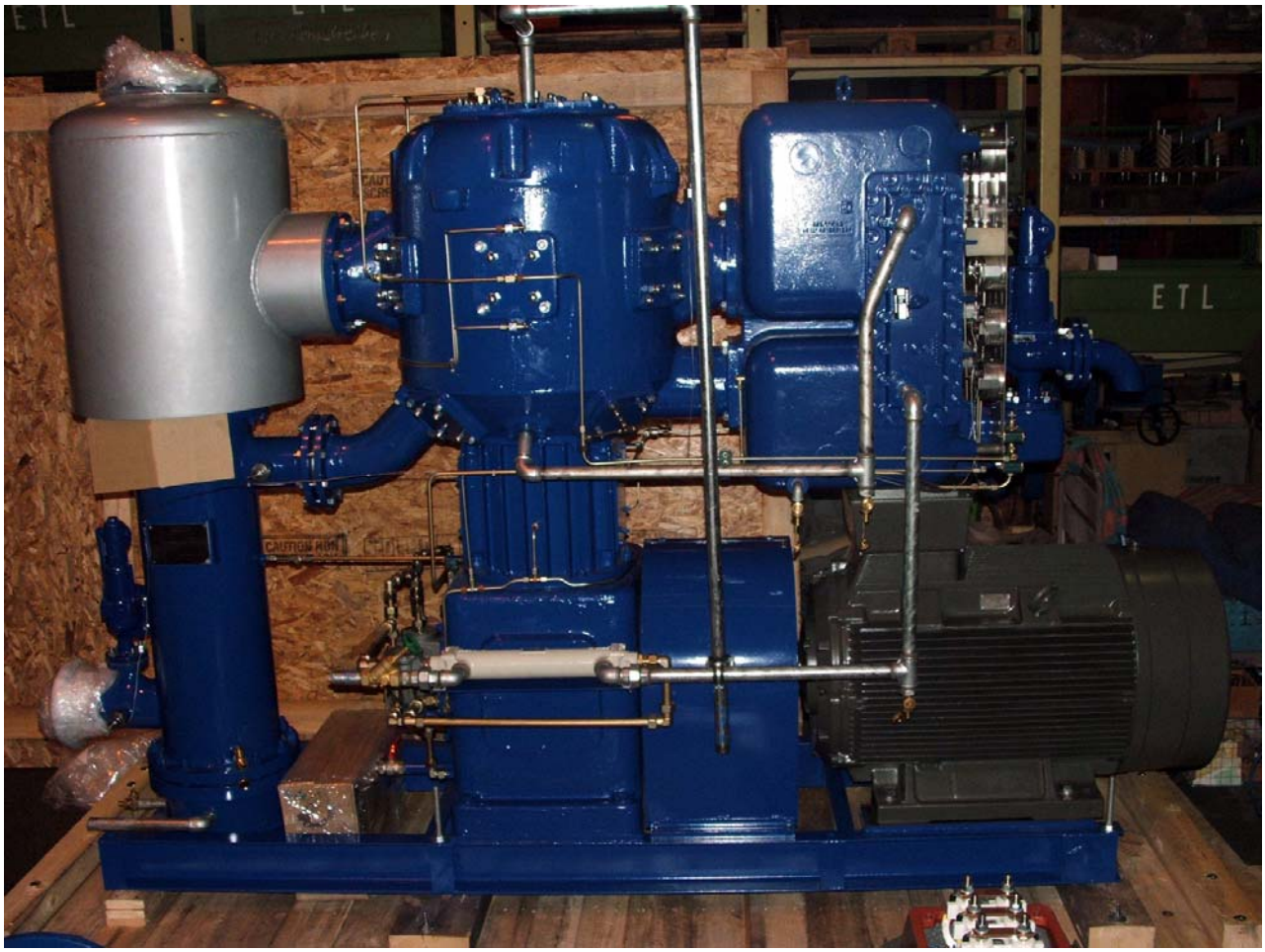
BORSIG

COMPRESSION ZM

TWO-PISTON COMPRESSOR



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Constant progressive machinery development creates the new opportunities in using "working medium – pressure air". As well, compression of the other technical gases gains ever-increasing significance.

This general trend of development is taken into account by us in the framework of the performed research activities and engineering developments.

Air compression for the general purpose (i.e. in metallurgic and mineral resource industry, foundry production, glass industry, construction material production, paper, food machine building industries) is still performed in the most efficient way by the reciprocating compressors, which are designed in accordance with the operating pressure of the most of air operated tools and equipment for the excessive pressure range from 6 kgf/cm^2 to 10 kgf/cm^2. In this regard, application of only crosshead design can provide the highest efficiency and lowest wear of compressors, even under conditions of uninterrupted continuous operation. Result of these considerations and purposeful performance of research and engineering activities corresponds to our newly manufactured

HIGHLY-EFFICIENT TWO-PISTON COMPRESSOR

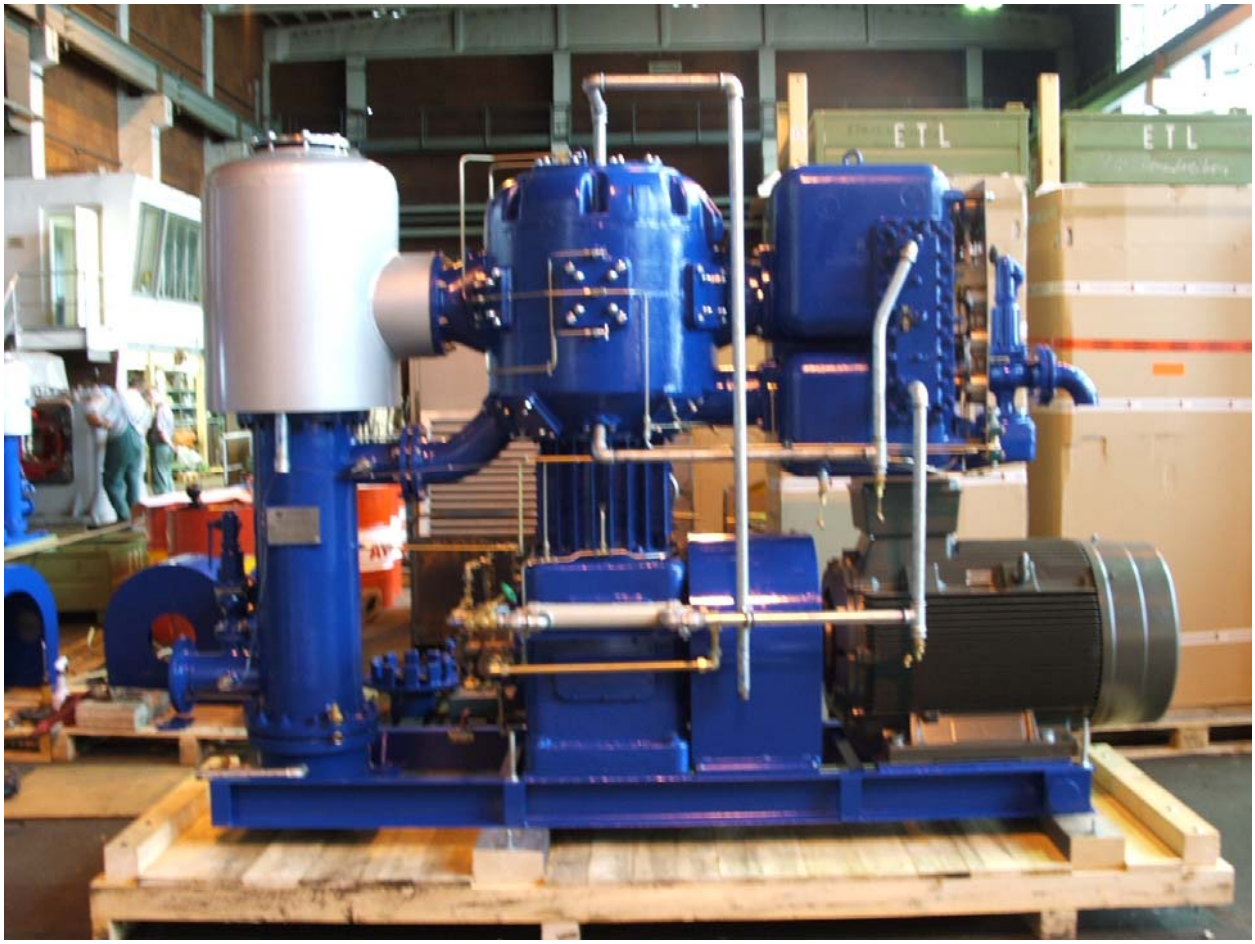
Compressor description:

The major concept of the new design is free from the regular principles of development, but still includes tested and well-proved design elements. The new design concept, which previously could hardly be applied in compressor building, is now exercised with this new type of compressor. This is two-piston, vertical design, differentiated from other types of design by the least required unit area.

Due to application of the two-piston type design, the sufficient increase in efficiency at the given rotations is achieved. Simultaneously, the two stage compression in one cylinder is able to be performed.

Two opposed counter-stroke pistons of the same diameter are located in this cylinder. Thus, there are four acting piston areas in one cylinder. Therefore, increase in efficiency is attained for almost 100% in comparison with the regular design compressors. In the described two-stage compressor three piston area acts as the 1st stage, and the lower area of the lower piston as the 2nd stage.

Due to movement of pistons in opposite directions, the sufficient piston displacement is being achieved between them, besides, the speed of the separate pistons is very small, which results in favorable effect on wear between piston rings and the cylinder well.



Pistons are directed by means of piston rods entering into each other and crossheads. The drive comes from the three-throw crankshaft. The lower piston is connected with the two external connection rods by means of external crosshead. Due to the fact, that one piston area works as the 2nd stage, then favorable force distribution is achieved via combination of the two connection rods. Crankshaft is designed in such a way that its external throws act as the main bearings. Balancing of the rotating mass is achieved via cone design of both inner crankshaft webs. Crankshaft rotates in the tunnel crank case. Crank case, as well as crossheads case, has quite large in size mounting holes. The valve fitting issue is closely observed. Compressor both stages are equipped with the inertia, spring, flat valves. Valves in the 1st stage cylinder head have the same dimensions as 2nd stage valves. However, suction and discharge valves are fitted with different springs. In order to prevent valves mixing-up during assembly, all suction valves are provisioned with bigger diameter of integration, than discharge valves.

Compressor depending on the type of its design is able to compress both air and non-aggressive, non detrimental to the health and hardly flammable gases.

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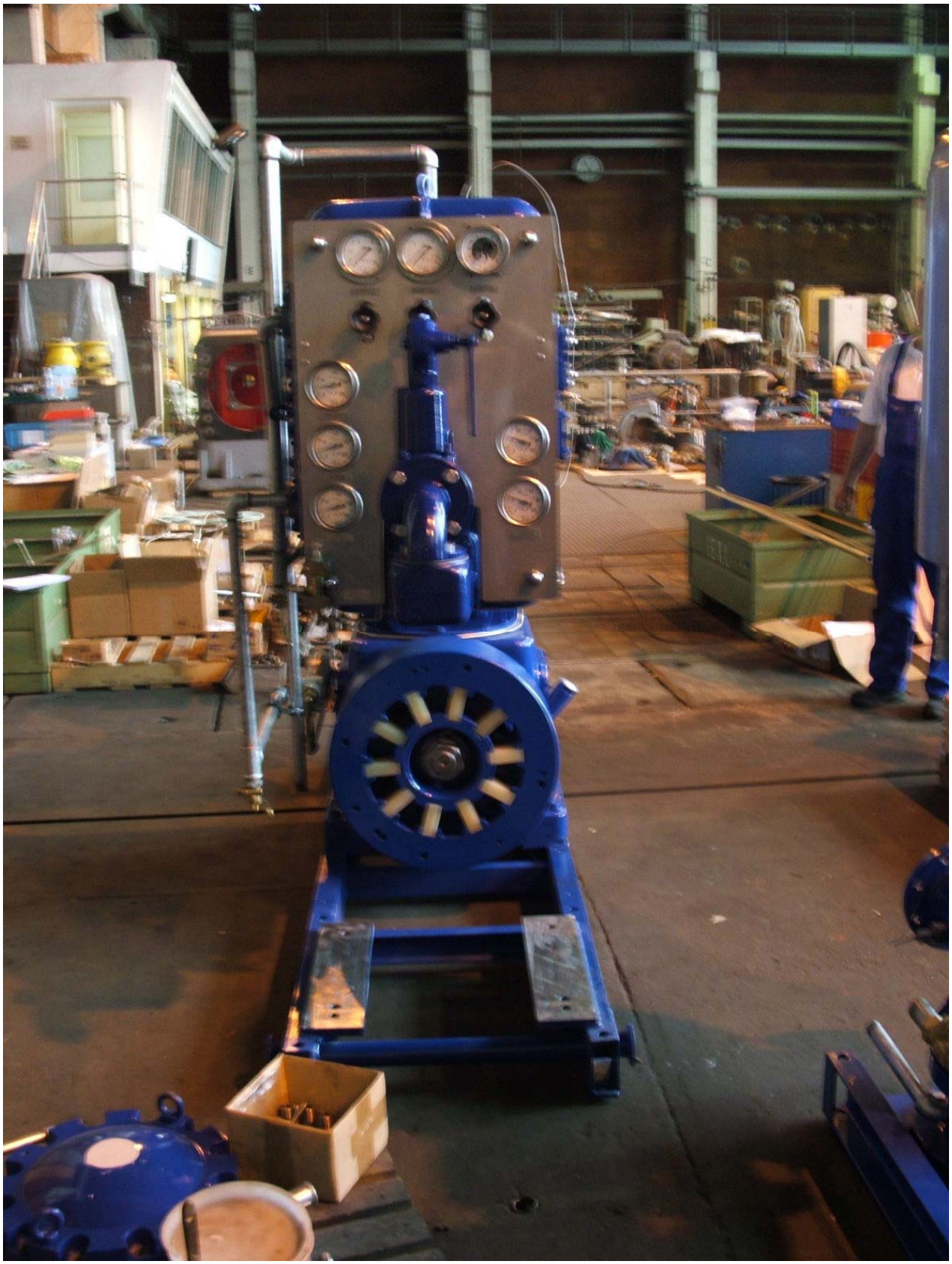
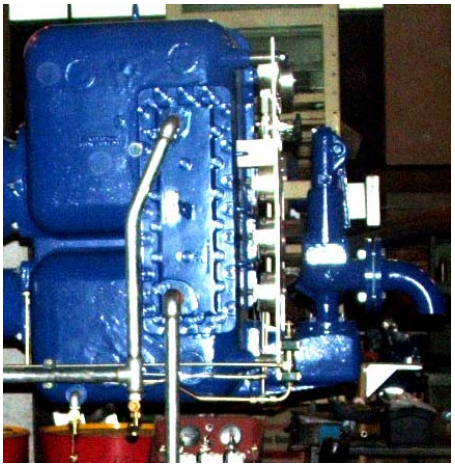


Adjustment

Compressor is equipped with the automated system of idle adjustment. Having attained the operating pressure set on the adjusting valve, all suction valves of compressor are forcedly kept in the open position by adjusting pistons and clamps. Suction valves are closed at operating pressure drop below the specified adjustable value, and compressor again starts to work for its full capacity. (Point-to-point adjustment: idle running-full load).





Checking equipment

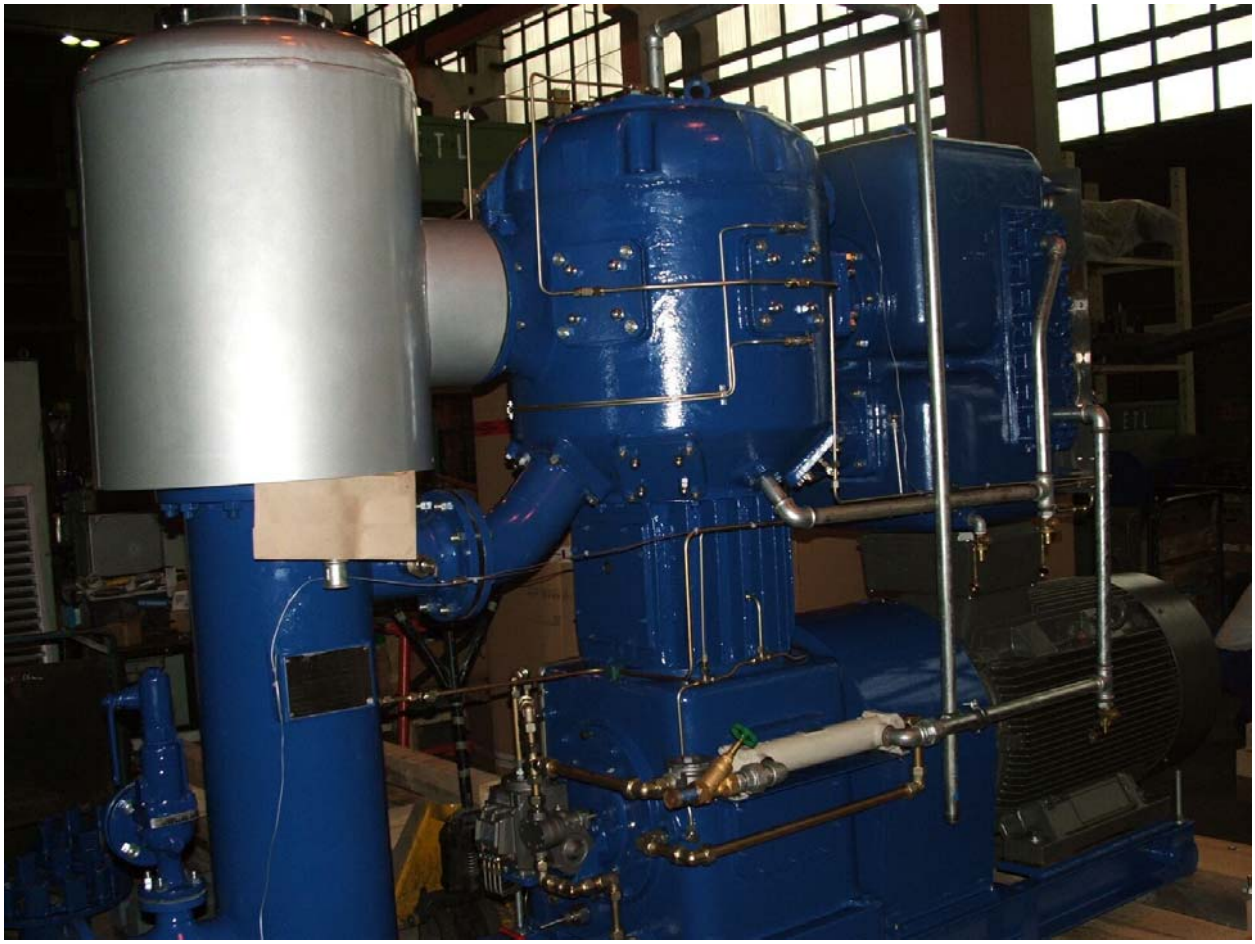
Regular delivery set includes remote thermometer, pressure gauge and safety valves of both pressure stages. Indicators assembled on the panel are obviously located on the intermediate cooler casing. The delivery set can be supplemented with the automated system of adjustment and control, if requested. The unattended operation of the compressor unit is maintained with this system, consisted of the compact unit.

Lubrication

Drive mechanism is lubricated with the help the oil flow circuit at pressure, supported with **gear-type pump** and set by pressure control valve. Using efficient oil cooler reduces grease aging property, and increases coefficient of the mechanical efficiency and wear characteristics.

The gear-type pump actuates **cylinder lubrication unit** with oil delivered in doses to separate lubrication points.

The most effective compressor oil consumption is attained via saving adjustment of lubrication system, so the processed compressed air can be considered as “containing small quantity of oil”. Oil filling to cylinders’ lubrication unit is automatic from the oil flow circuit of drive mechanism’s lubrication system.

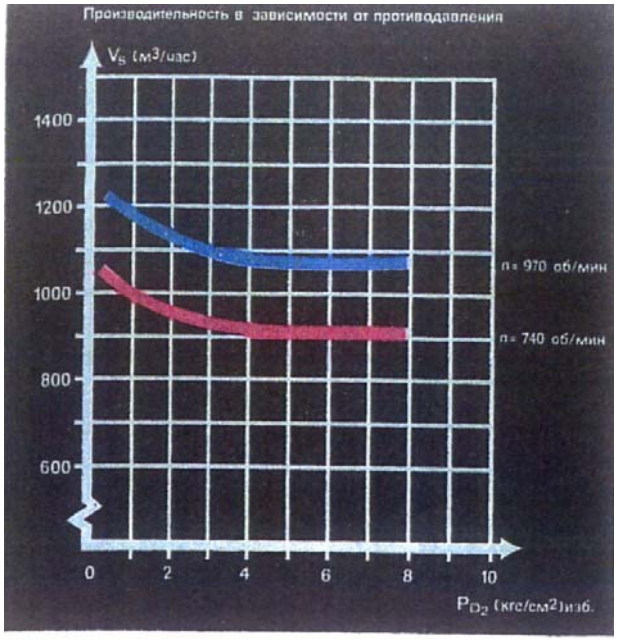


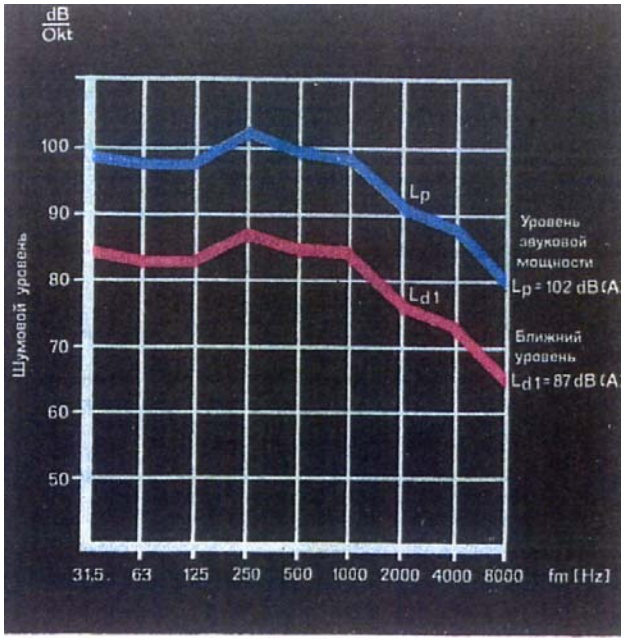
Cooling

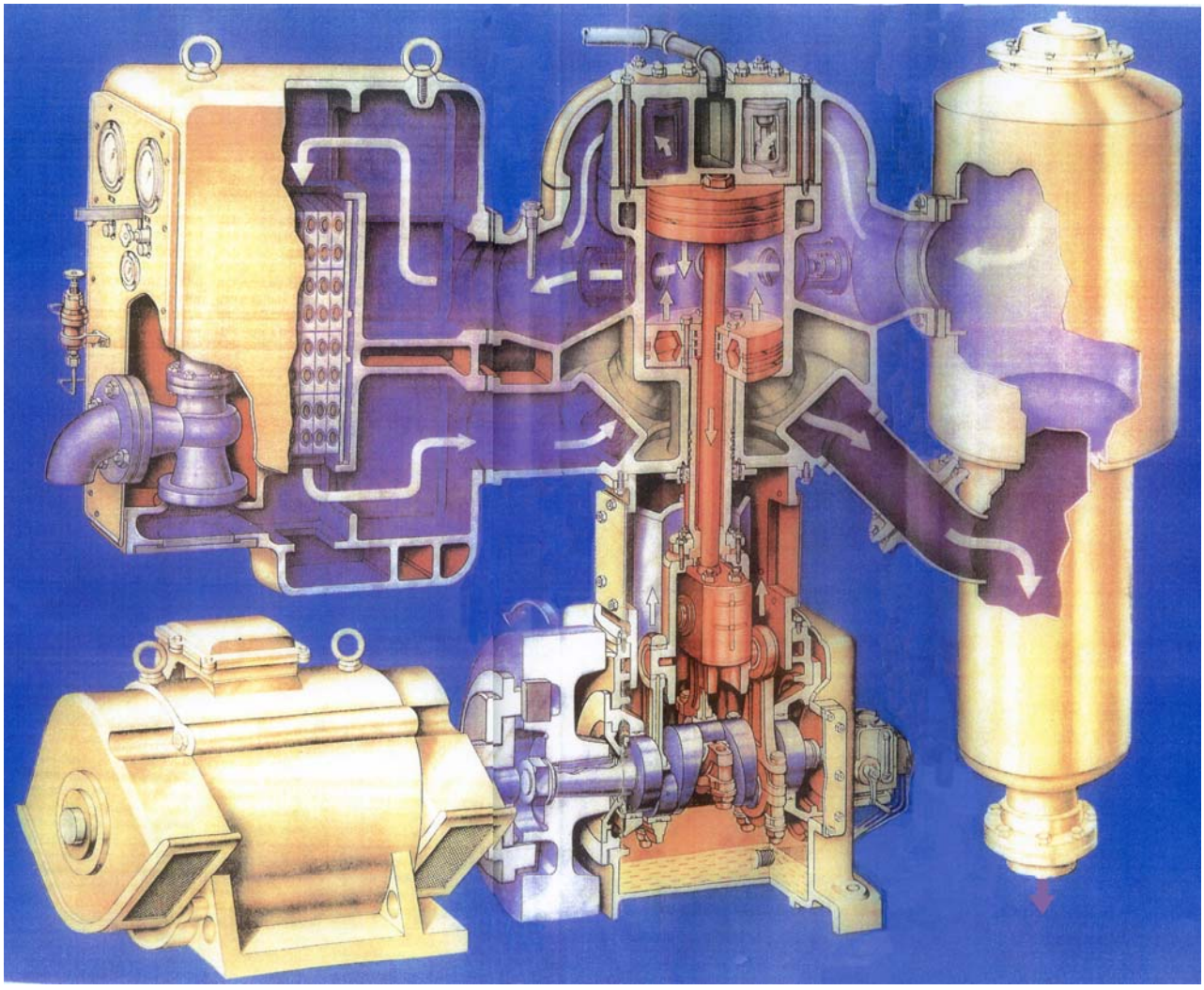
High-capacity wear-resistant oval-tube ribbed cooler provides the reverse cooling of pressure air almost to the level of the inlet temperature, along with the cooling of pressurized oil, cylinder faces, valve chambers, and cylinder heads. Installation place saving and elimination of any gas pipelines usage is reached due to intercooler layout over drive motor. The compressor unit is also provisioned to be equipped with the additional cooler without any further demand in installation area.

Actions for reduction of noise and unwanted pulsation

Carefully selected and agreed damping tanks, which reduce extension vibration of air (pulsation), therefore reducing vibration of connected pipelines, and then overcoming noise, are directly connected with the compressor inlet and discharge branch pipes. Suction nozzle mounted in tank from the inlet side serves for further inlet noise reduction during suction.


Производительность в зависимости от противодавления
V_S (м³/час)
1400
1200
1000
800
600
n = 970 об/мин
n = 740 об/мин
0
2
4
6
8
10
P_{D_2} (кгс/см²)изб.

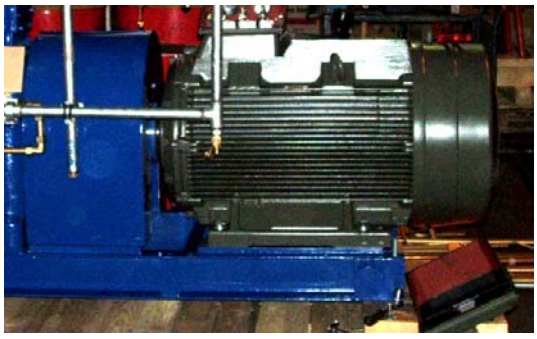

dB
Okt
Шумовой уровень
100
90
80
70
60
50
Lp
Ld1
Уровень звуковой мощности
Lp = 102 dB (A
Ближний уровень
Ld1 = 87 dB (A
31,5
63
125
250
500
1000
2000
4000
8000
fm [Hz]



Drive

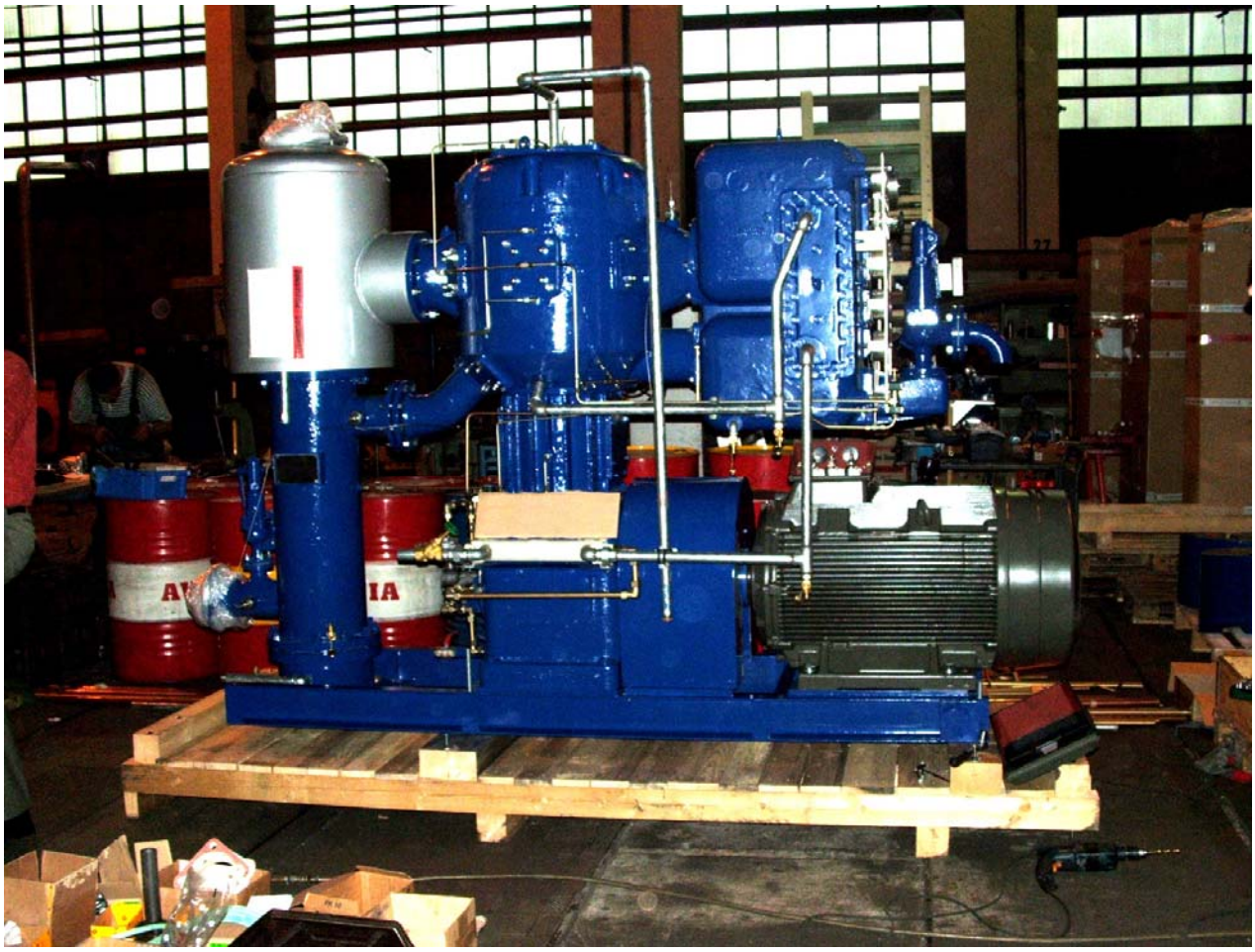
Compressor is motor driven.

The advantage of the short-stroke at relatively high revolutions allows the direct connection of compressor and motor, performed in this case through the elastic claw coupling. Thus, all other elements of force transfer are eliminated. If application of belt driven high speed motor at the compressor rotations in 750 rpm and less conditions in most cases consider profitable, than at compressor rotations in 1000 rpm is inappropriate. The price difference of motors with the same power and rotations in 1000 and 1500 rpm balances with the cost of pulleys and belt transfer system. Besides, belt type involves the significant demand in installation site, causing in most cases the simultaneous increase of installation noise.



Balancing of inertia forces – Basement – Installation

The two-piston design provides the optimal smoothness of machine running. Due to masses naturally moving in opposed directions, without extra counterbalance, their action is balanced. Balancing of machine inertia forces approximately corresponds to the balancing level of machines mass with so called "boxer" type cylinders.



However the last requires at least two cylinders with horizontal arrangement that means bigger installation site. The described compressor design combines the advantages of opposed "boxer" cylinders with horizontal arrangement and vertical single-cylinder design types. No machines of V type cylinder arrangement, nor L-type, can provide the similar balancing of inertia forces. Normally, compressor unit with motor, protection device for flywheel and coupling, and inside the unit located pipelines of cooling water are delivered in assembly on the regular cross-sectional bed frame. Thus, basement and installation activities expenditures are minimized.

TECHNICAL SPECIFICATION

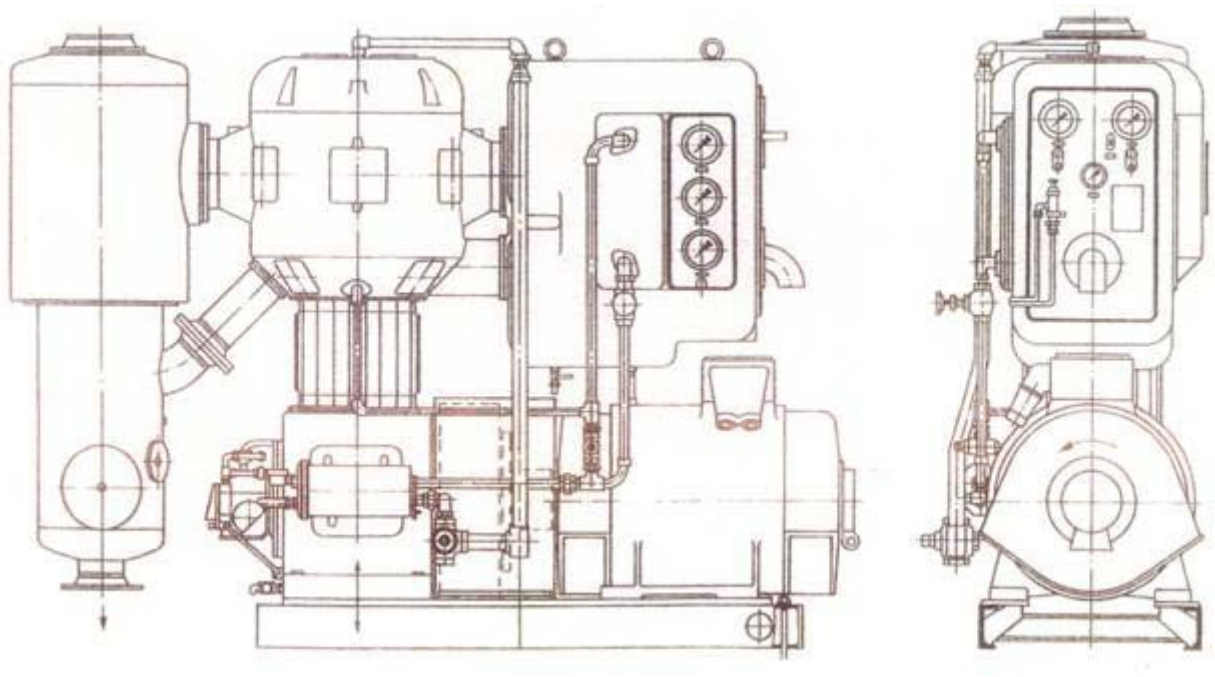
Stationary 2-stage water-cooling reciprocating double-acting compressor units of A2HD3K-100/320: EG.

1. Compressor — № 522.522

Suction capacity	1070m3/h +7%	750 ± 5%
Pressure in discharge pipe: normal max	8 kgf/cm^2 g	8 kgf/cm^2 g 10 kgf/cm^2 g
Number of stages	2-stages	
Number of cylinders	1	
Rotations	970rpm	735rpm
Power on coupling at 8 kgf/cm^2 g	103 kW	72 kW
Consumption of cooling water	2 to 3 m^3/h at incoming water t 15 ^{0}C	
Compressor weight (including flywheel)	1580 kg	
Weight of compressor unit in ready-to-operate condition (including coolers, damping tanks, motor, coupling, check and measuring devices, and bed frame)	3500-4100 kg (depends on the applied motor)	

2. Drive motor

Three-phase induction motor, design M 101 as required:	
Type of protection	JP23, JP24
Rated rotations	1000rpm, 750rpm, 900rpm (60Hz)
Voltage	380V, 500V
Frequency	50Hz, 60Hz (as on special request)



Length: approx. 2800 - 3015 mm (Depending on type of motor)
Height: approx. 1975 mm
Width: approx. 1000 mm

Compressor A2HD3K-100/320:EG

1. Technical characteristics of compressor unit A2NDKZK-100/320 EG, manufactured in Germany (Borsig ZM Compression) with standard list of equipment:

Description	Unit of meas.	Value
Suction capacity	m^3/h	750 ± 5%
Operating pressure	Mpa	1
Type of compressor	**2HD3K-100/320:EG**	
Quantity of stages	ea	2
Quantity of cylinders in each stage	ea	1
Cylinder diameter	mm	320
Piston stroke	mm	100
Average speed, piston	m/sec	2,5
Inertia moment of flywheel with coupling	$kg*m^2$	20
Rotations	rpm	735
Shaft capacity at maximum load	kW	78
Idle shaft capacity, apprx	kW	16
Time of idle run	min	15
Rated voltage	B	Y/Δ 380/660 or 500
Frequency	Hz	50
Maximum permissible inlet temperature (I stage / II stage)	°C	160
Type of protection /insulation (motor)	IP55 / ISO F	
Level noise w/o case	Db	84 + 3
Overall dimensions (length x width x height) w/o case, apprx	mm	3000x1000x2000
Weight without case	kg	3.565
Weight with case	kg	4.015
Type of cooling	Water	
Consumption of cooling water	m^3/h	3-5
Connection size for compressed air / cooling water	NW	200/125 (suct/disch) 1
Temperature of cooling water	°C	15
Pressure of cooling water (max)	bar	3
Capacity of oil system	L	26.5
Oil entrainment	MG/M3	30
Ambient pressure	°C	Up to 40

2. Delivery scope / list of equipment for compressor unit A2HD3K-100/320:EG:

- Compressor unit, consisting of drive mechanism with flywheel, intermediate part and cylinder,
- Vertical design, one-axle, 2-stage,
- 2-piston structure: 2 counter-stroke pistons located in one cylinder and form 3 compression volumes,
- Pistons are directed by means of single piston rods entering into each other and crossheads at the same compressor axle,
- Drive from three-throw crankshaft and three connection rods. Two external connection rods are connected with external crosshead, the intermediate one – with internal crosshead,
- Lubrication system of drive mechanism consists of lub-oil pump, directed connected from crankshaft, suction line, pressure control valve, oil cooler and pipelines,
- Lub - oil is delivered in doses to separate lubrication points by means of cylinders' lubrication unit. Oil filling to cylinders' lubrication unit is automatic from the oil flow circuit of drive mechanism's lubrication system,
- Flywheel/cylinder cooling by means of cooling water,
- Piston and guide rings of GG, oil reflector,
- mechanical testing,
- painting.

Compressor unit includes:

- 2HD3K-100/320 compressor,
- Pulsation dampener (suction side of the 1st stage),
- Safety valve of the 1st stage,
- Safety valve of the 2d stage,
- Pulsation dampener (discharge side of the 1st stage / suction side of the 2d stage),
- Pulsation dampener (discharge side of the 2d stage),
- Electric motor for direct drive,
- Flywheel, coupling, protection device,
- Pulse tank,
- Intermediate and additional coolers,
- Safety valves at discharge side of each stage,
- Ground plate,
- Local thermometer for measuring downstream of the first and second stages, at the gas outlet and oil temperature, made as machine thermometers as per DIN 16181-16195,
- Manometers for intermediate and final pressure and oil pressure at local panel,
- Painting of the whole unit,
- Factory testing in assembled condition,
- The unit is ready for start up without further assembly upon installation on foundation, and connection – delivery border: pulse tank/additional cooler,
- Documentation.

PRODUCTION PROGRAMME

- Reciprocating compressors of angular design
- Booster compressors and circulating gas pumps
- Refrigeration compressor of angular design
- Oil-free compressors
- Vertical reciprocating compressors for low, medium, and high pressure
- Mobile and stationary compressor units with motors and diesel engines
- Blowers of Rutsa system