

海绵钛真空自耗炉专用水冷变压器

Water-cooled Transformer for Sponge Titanium Vacuum Consumable Furnace

■ 产品概述(Production Introduction)

钛及其合金由于密度小(4.51g/cm³)、强度高(有的达到1000MPa)、比强度大、高低温性能优异,因此是首先被广泛应用于航空、航天等行业,成为军事工业不可或缺的结构材料。

直流真空熔炼是钛等稀贵金属及高性能合金钢熔炼所必须采用的工艺,因而真空电弧炉配套电源的水冷整流变压器是关键器件。我公司配套的直流真空自耗熔炼炉专用大电流水冷整流变压器能够满足真空自耗熔炼炉1T到12T的产品范围,单机最大满载参数2*36KA/60VDC。经过学习吸收世界名牌ALD公司先进技术,降低了现场安装整流变压器与整流柜之间大截面铜母排的难度,减小了整个电源的体积,缩小了占地面积。另考虑到熔炼过程中起弧电压为60V,而熔炼电压仅40V左右,应用了两套双反星形可控整流单元并联。随单炉可熔炼金属材料重量的不同为50~75V,熔炼过程中一般随单炉可熔炼金属材料重量的不同为30~45V,再次优化设计开发了全系列专用大电流水冷整流变压器。可根据客户要求在主电路中直流输出端增加平波电抗器。

本公司生产的水冷整流变压器用作整流装置的电源变压器,主要应用于海绵钛真空自耗炉等稀有金属冶金行业。该产品具有损耗低、噪声低、结构紧凑、供电可靠、抗冲击和抗短路能力强等优点,并可以根据客户要求定制多结构形式多脉波的水冷整流变压器。

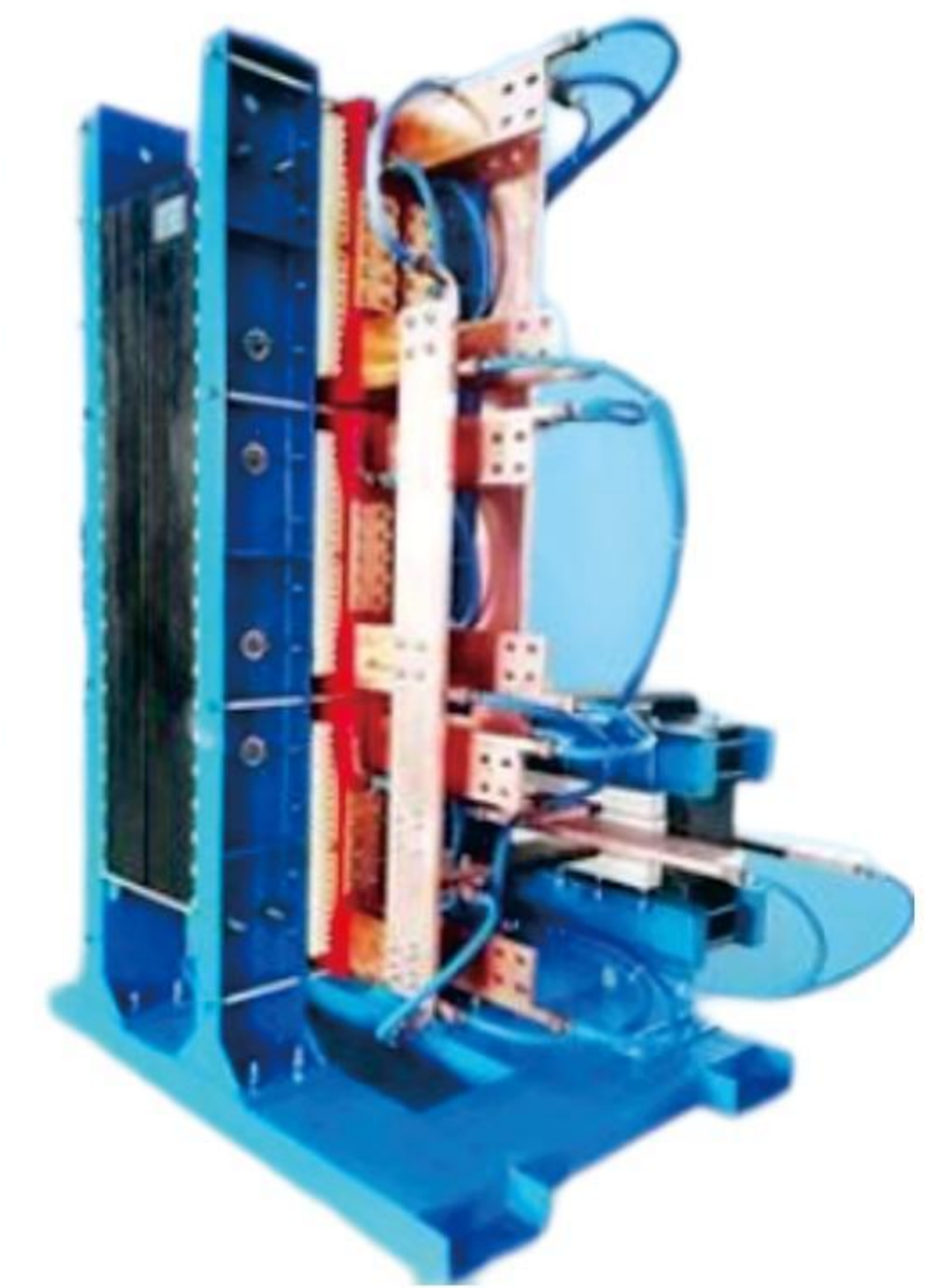
Titanium and its alloys are widely used in aviation, aerospace and other industries due to their low density (4.51g/cm³), high strength (some reaching 1000MPa), high specific strength, and excellent high and low temperature properties, and have become indispensable structural material for the military industry.

DC vacuum melting is a necessary process for melting titanium and other rare and precious metals and high-performance alloy steel. Therefore, the water-cooled rectifier transformer is a key component for the vacuum electric arc furnace supporting power supply. Our company's high-current water-cooled rectifier transformer dedicated to DC vacuum consumable melting furnace can meet the range of vacuum consumable melting furnaces from 1T to 12T, and the maximum full load parameter of a single machine is 2*36KA/60VDC. After learning and absorbing the advanced technology of the world-famous ALD company, we have reduced the difficulty of on-site installation of large-section copper busbars between the rectifier transformer and the rectifier cabinet, and reduced the size of the entire power supply and the floor space. In addition, considering that the arcing voltage during the smelting process is 60V, while the smelting voltage is only about 40V, two sets of double reverse star controllable rectifier units in parallel are used. Depending on the weight of the metal material that can be smelted in a single furnace, the voltage is 50 ~ 75V. During the smelting process, generally depending on the weight of metal materials that can be smelted in a single furnace, the voltage is 30 ~ 45V. We have optimized the design and developed a full series of dedicated high-current water-cooled rectifier transformers. A smoothing reactor can be added to the DC output of the main circuit according to customer requirements.

Our water-cooled rectifier transformer is used as power transformers for rectifier devices. It is mainly used in rare metal metallurgical equipment such as sponge titanium vacuum consumable furnaces. This product has the advantages of low loss, low noise, compact structure, reliable power supply, strong impact resistance and short-circuit resistance. Water-cooled rectifier transformers with multiple structures and multiple pulse waves can be customized according to customer requirements.

■ 产品特点(Product Feature)

- 1.电气性能稳定:结合行业应用特点优化设计方案。精确的电气参数设计和科学的结构设计,保证产品的电气性能优良,高压线圈采用风冷设计(国内布置)或水冷设计(欧洲布置),采用轴向多风道结构,降低通风阻力,保证高效的通风和散热。低压线圈采用水冷结构,保证高效的散热
- 2.动稳定程度高:产品高压绕组箔绕(国内布置)或饼式叠压(欧洲布置),低压线圈采用铜管或铜板绕组(国内布置)或铜板拼焊绕组(欧洲布置),有极高的机械强度,具有较强的抗突发能力,以满足极恶劣的负载环境
- 3.热稳定性好:先进仿真计算,优化产品的发热部位及最热点温升,留有充分的温升裕度,选用进口杜邦公司N0mex-T410绝缘材料,保证产品绝缘和耐温的高可靠性。根据水冷散热特性,合理分配水冷管路水流量,达到最佳冷却效果,铁芯内置水冷换热器,强化铁芯散热能力,采用30Q120高导磁硅钢片,同时采用先进的多级步进多级叠片方式,有效降低了空载损耗、空载电流和噪声。在设计、制造过程中较好地消除了变压器大电流漏磁涡流引起局部发热问题,产品具有极高的可靠性



- 4.过载能力强：产品具有较强的过负载能力和过电压能力，产品设计、制造充分考虑用户工业电网和负载特性，电气性能、温升、绝缘耐压及附件选择等各方面均满足一定的过载要求，比同容量的电力变压器的阻抗高30%，以抑制di/dt，限制短路电流，有效保护整流元件
- 5.性能指标优越：空载电流设计、损耗指标制造值低于同容量国标系列变压器，充分考虑用户使用的经济性和可靠性
- 6.水系统管路设计安全可靠，主管路采用不锈钢管路或铜管路，满足防腐要求，出水嘴采用国际标准的密封螺纹，有效防止渗漏。分支连接管路采用耐高温尼龙纤维与橡胶复合管路或聚四氟乙烯管路，保证可靠的耐高温耐压耐久性
- 7.进出水设计温差低于5℃，水流速设计值低于1.5m/s，工作压力设计值低于3bar,保证水冷系统工作的稳定可靠
- 8.采用铜管绕组的卧式结构或者铜板绕组的侧立结构，可根据客户要求对变压器采用“三防漆”处理（防盐雾、防湿热、防霉菌），装饰性好，耐腐蚀性强、保光性好、保色性较好，有良好的流平性和遮盖力，结构简化，外形美观
- 9.整流变压器配温度保护装置，由高集成度、带总线通讯的高可靠开关电源模块等部件组成，用于测量、控制、保护、通讯

- 1.Stable electrical performance: optimize the design scheme based on industry application. Precise electrical parameter design and scientific structural design ensure excellent electrical performance of the product. To ensure efficient ventilation and heat dissipation, the high-voltage coil adopts air-cooling design (domestic layout) or water-cooling design (European layout), and an axial multi-duct structure to reduce ventilation resistance. The low-voltage coil adopts a water-cooling structure to ensure efficient heat dissipation
- 2.High degree of dynamic stability: The high-voltage coil is foil-wound (domestic layout) or pie-type laminated (European layout), and the low-voltage coil uses copper tube or copper plate winding (domestic layout) or copper plate tailor-welded winding (European layout), with extremely high mechanical strength and strong anti-sudden ability to meet extremely harsh load environments
- 3.Good thermal stability: advanced simulation calculations optimize the temperature rise of the heating parts and hottest spots of the product, leaving sufficient temperature rise margin. Imported DuPont N0mex-T410 insulation material is selected to ensure high reliability of insulation and temperature resistance. According to the water-cooling heat dissipation characteristics, the water flow in the water-cooling pipeline is reasonably distributed to achieve the best cooling effect. The iron core has a built-in water-cooling heat exchanger to enhance the heat dissipation capacity of the iron core. It uses 30Q120 high magnetic permeability silicon steel sheets and multi-stage stepping multi-stage lamination method effectively reduces no-load loss, no-load current and noise. During design and manufacturing, local heating problems caused by large current leakage magnetic eddy currents in the transformer are better eliminated, and the product has extremely high reliability
- 4.Strong overload capability: the product has strong overload capability and overvoltage capability. The design and manufacturing fully consider the user's industrial electrical network and load characteristics. The electrical performance, temperature rise, insulation withstand voltage and accessory selection, etc. meet certain overload requirements. To suppress di/dt, limit short-circuit current, and effectively protect rectifier components, the impedance is 30% higher than that of a power transformer of the same capacity
- 5.Superior performance indicators: no-load current design and loss indicator manufacturing values are lower than the national standard series transformers of the same capacity, fully considering the economy and reliability for users
- 6.The water system pipeline design is safe and reliable. The main pipe uses stainless steel pipes or copper pipes to meet anti-corrosion requirements. The water outlet uses international standard sealing threads to effectively prevent leakage. The branch connecting pipes use high-temperature resistant nylon fiber and rubber composite pipes or polytetrafluoroethylene pipes to ensure reliable temperature and pressure resistance and durability
- 7.The design temperature difference between inlet and outlet water is less than 5°C. The design value of water flow rate is less than 1.5m/s. The design value of working pressure is less than 3bar, ensuring the stability and reliability of the water cooling system
- 8.Adopt the horizontal structure of copper tube windings or the side-standing structure of copper plate windings. The transformer can be treated with "three-proof paint" according to customer requirements (anti-salt spray, anti-humidity and heat, anti-mold). It has good decorative properties, strong corrosion resistance, good gloss retention, good color retention, good leveling and hiding power, simplified structure and beautiful appearance.
- 9.The rectifier transformer is equipped with a temperature protection device, which is composed of highly integrated, highly reliable switching power supply module with bus communication and other components, used for measurement, control, protection and communication

■ 技术规格(Technical Specification)

- 1.工作海拔：不超过2000米,2000米以上每升高100米降额1%，最高3000米
- 2.户内相对湿度：日平均≤95%，月平均≤90%
- 3.最高环境温度：+40℃，40℃以上降额使用
- 4.最低环境温度：-25℃
- 5.系统额定频率：50~60Hz
- 6.安装场所：户内柜内
- 7.储存温度：-40℃~+70℃
- 8.盐雾：≤0.5mg/m³
- 9.机械活性物质：沙≤300mg/m³,尘（漂浮）≤0.4mg/m³,尘（沉积）≤350mg/m²/天
- 10.地面水平加速度与垂直加速度：≤0.25g/0.125g

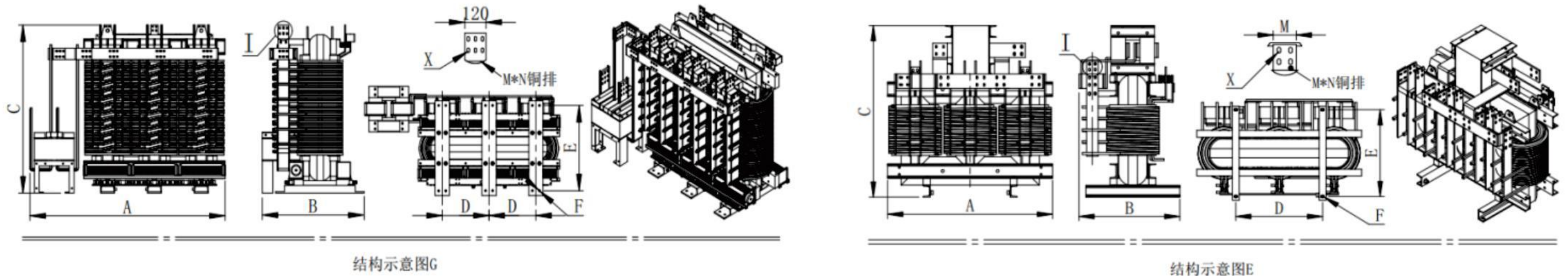
1. Working Altitude: ≤ 2000m, and use values derated by 1% for every 100 meters when above 2000m. The tolerance temperature is up to 3000m
2. Indoor Relative Humidity: daily average ≤95%, monthly average ≤90%
3. Maximum Ambient Temperature: +40°C, use with derated values when above 40°C
4. Minimum Ambient Temperature: -25°C
5. System Rated Frequency: 50 ~ 60Hz
6. Installation Place: Indoor cabinet
7. Storage Temperature: -40 ~ +70°C
8. Salt Spray: ≤0.5mg/m³
9. Mechanically Active Substances: sand ≤300mg/m³, dust (floating) ≤0.4mg/m³, dust (sediment) ≤350mg/m²/day
10. Ground Horizontal Acceleration and Vertical Acceleration: ≤0.25g /0.125g

■ 执行标准(Applicable Standard)

- GB1094.1 Power transformers-Part 1: General
- GB1094.3 Insulation levels, dielectric tests and external clearances in air
- GB1094.11 Power transformer-Part 11: Dry-type transformer
- JB/T9640 Arc furnace transformer
- JB/T 8636-1997 Power convertor transformer
- GBT21419 Transformers, power supplies, reactors and similar products - EMC requirements
- GBT10228 Specification and technical requirements for dry-type power transformers
- GB3859.3 Semiconductor convertors - Transformers and reactors
- JB/DQ2113 Electrochemistry rectify transformer

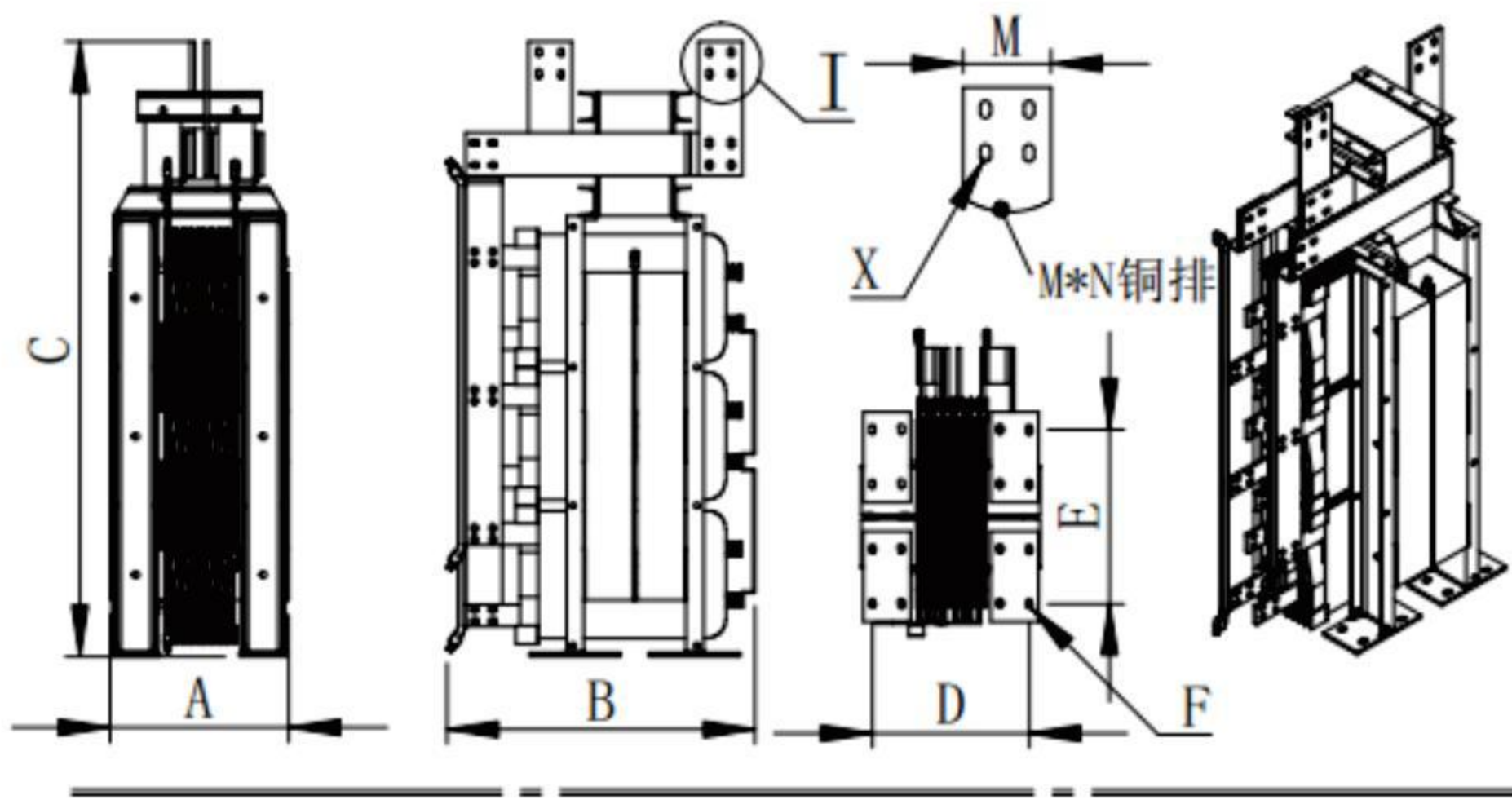
■ 产品尺寸图(Product Size)

国内布置Domestic Layout

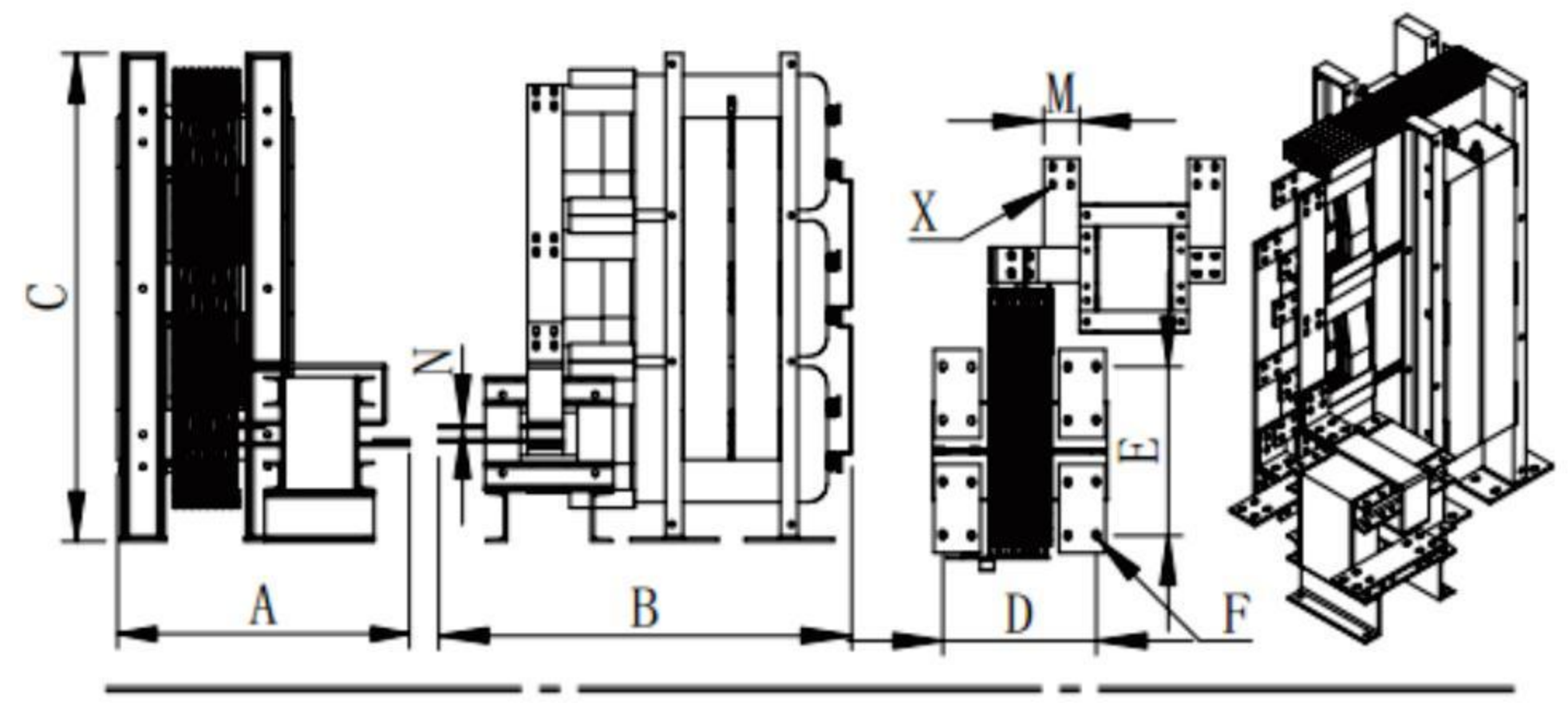


主要参数Main Parameters					型号Type	图号 Picture No.	产品规格Product Specification						
序号 No.	输出直流 Output Current (kADC)	输入电压 Input Voltage (VAC)	功率 Power (kVA)	输出电压 Output Voltage (VDC)			A*B*C (mm)	D*E (mm)	F (mm)	X (mm)	M*N (mm)	材质 Material	重量 Weight (kg)
1	15	400/690	878	40	ZSGS878-0.4-0.04-1	E	1800*850*1450	1000*900	16*26	12	100*8*2	Cu	2000
2	15	400/690	1400	55	ZSGS1400-0.4-0.055-1		2050*1000*1870	1000*900	16*26	12	100*8*2	Cu	3450
3	16	400/690	1140	45	ZSGS1140-0.4-0.045-1		1550*800*1875	800*750	16*26	12	100*10*2	Cu	2800
4	18	400/690	2000	75	ZSGS2000-0.4-0.075-1	G	2250*1200*1800	500*1000	16*26	12	100*12*2	Cu	4200
5	20	400/690	1600	55	ZSGS1600-0.4-0.055-1		2050*1100*1770	500*1000	16*26	12	100*12*2	Cu	3550
6	24	400/690	1850	52	ZSGS1850-0.4-0.052-1		2200*1150*1770	500*1000	16*26	14	120*12*2	Cu	4300
7	24	400/690	1960	55	ZSGS1960-0.4-0.055-1		2300*1200*1770	500*1000	16*26	14	120*12*2	Cu	4300
8	25	400/690	2400	55	ZSGS2400-0.4-0.055-1		2250*1200*1800	500*1000	18*28	14	120*14*2	Cu	4600
9	30	400/690	2000	45	ZSGS2000-0.4-0.045-1		2250*1200*1800	500*1000	18*28	16	120*14*2	Cu	4350
10	30	400/690	2670	75	ZSGS2670-0.4-0.075-1		2400*1500*1850	500*1000	20*30	16	120*14*2	Cu	4700
11	30	400/690	2800	80	ZSGS2800-0.4-0.08-1		2400*1500*1850	500*1000	20*30	16	120*14*2	Cu	4750
12	36	400/690	2950	55	ZSGS2950-0.4-0.055-1		2400*1200*1850	500*1000	20*30	16	140*14*2	Cu	5500
13	36	400/690	3450	75	ZSGS3450-0.4-0.075-1		2400*1200*1900	500*1000	20*30	16	140*14*2	Cu	5900

欧洲布置European Layout



结构示意图E



结构示意图G

主要参数Main Parameters					型号Type	图号 Picture No.	产品规格 Product Specification						
序号	输出直流 Output Current (kADC)	输入电压 Input Voltage (VAC)	功率 Power (kVA)	输出电压 Output Voltage (VDC)			A*B*C (mm)	D*E (mm)	F (mm)	X (mm)	M*N (mm)	材质 Material	重量 Weight (kg)
1	4	400/690	220	36	ZSGS220-0.4-0.036-1	G	450*650*1450	400*400	16*26	12	80*12	Cu	1000
2	6	400/690	325	36	ZSGS325-0.4-0.036-1		500*650*1450	450*450	16*26	12	100*15	Cu	1300
3	8	400/690	435	36	ZSGS435-0.4-0.036-1	E/G	600*700*1500	550*550	16*26	12	100*20	Cu	1450
4	10	400/690	545	36	ZSGS545-0.4-0.036-1		650*850*1550	600*600	16*26	12	120*20	Cu	1600
5	12.5	400/690	740	20	ZSGS740-0.4-0.02-1	G	650*850*1600	600*600	16*26	12	120*25	Cu	1800
6	16	400/690	1140	45	ZSGS1140-0.4-0.045-1		1000*1200*1900	900*900	16*26	14	140*25	Cu	2800
7	20	400/690	207	6	ZSGS207-0.4-0.006-1	E/G	470*600*1150	425*425	14*24	14	140*30	Cu	850
8	20	400/690	1450	40	ZSGS1450-0.4-0.04-1	G	1000*1400*1900	900*900	18*28	14	140*30	Cu	3250
9	24	400/690	1960	55	ZSGS1960-0.4-0.055-1	G	1000*1400*2000	900*900	18*28	14	140*40	Cu	4000
10	30	400/690	2000	45	ZSGS2000-0.4-0.045-1		1200*1400*2000	1000*1000	20*30	16	150*40	Cu	4500