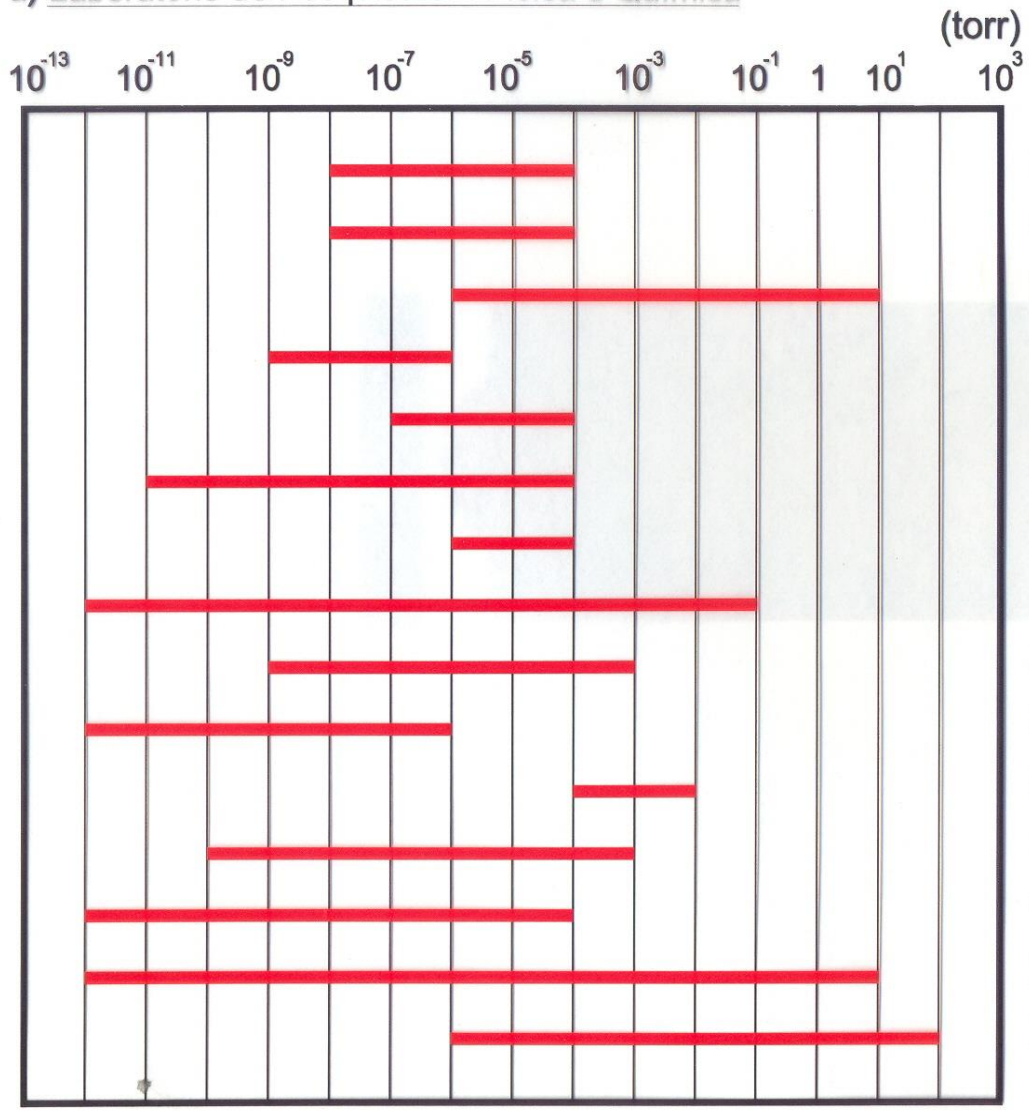
BOMBAS DE VÁCUO - 1

05 - ABRIL - 2016

USP - INSTITUTO DE FÍSICA

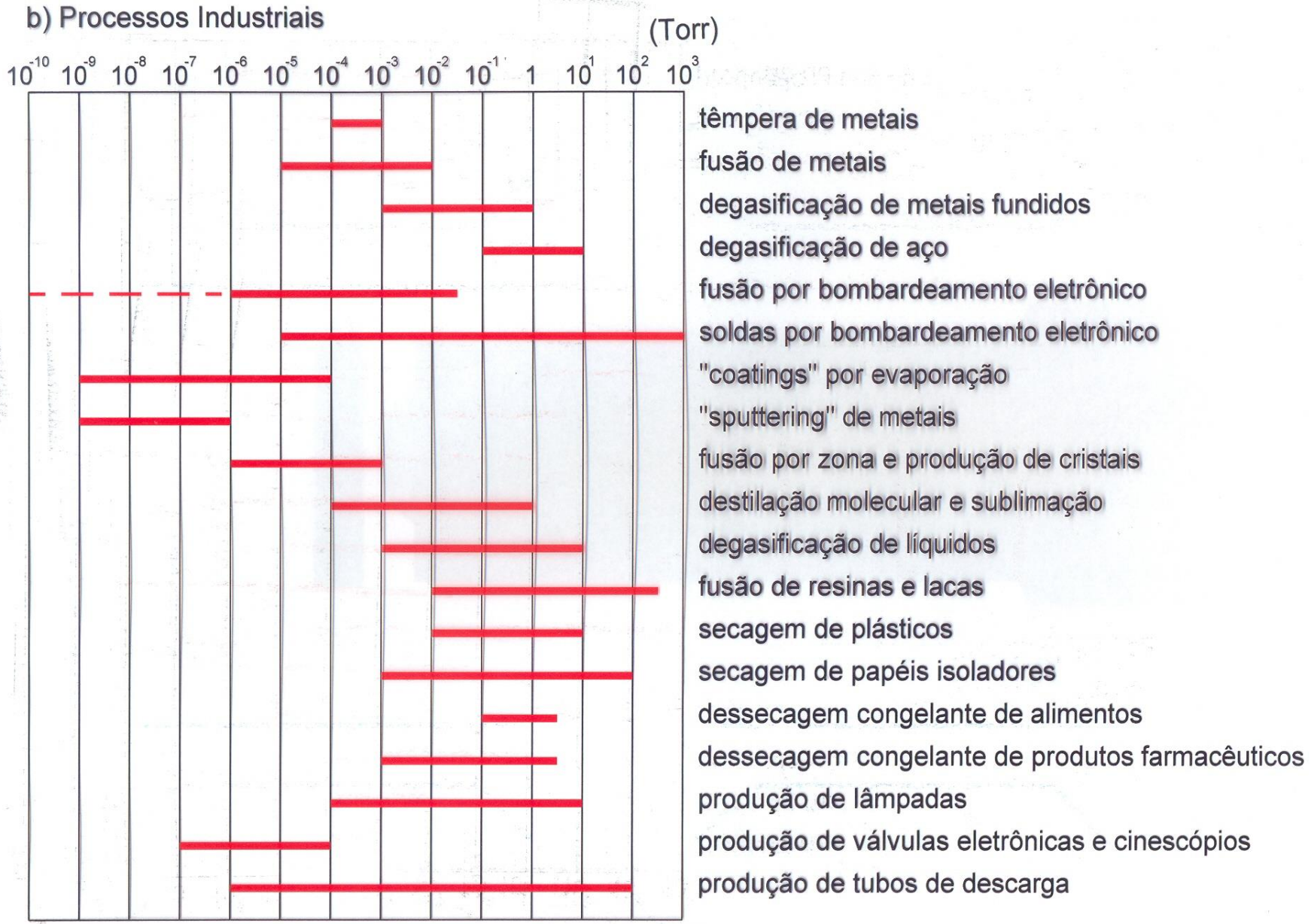
ALGUMAS APLICAÇÕES DO VÁCUO E SUAS FAIXAS DE PRESSÃO

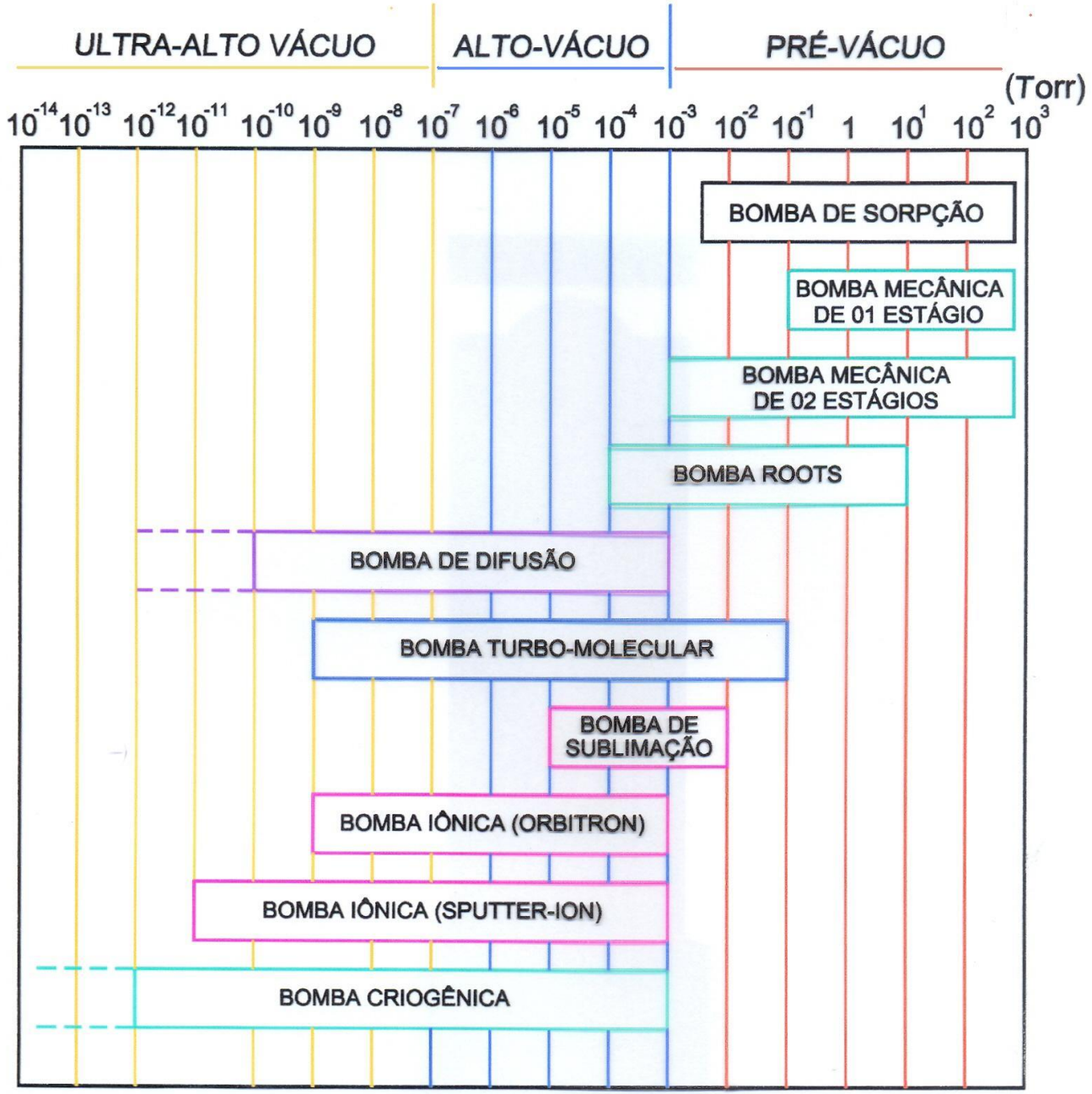
a) Laboratório de Pesquisa em Física e Química



- espectrômetro de massa
- equipamento de feixe molecular
- fontes de íons
- aceleradores de partículas
- microscópios eletrônicos
- equipamento de difração de elétrons
- espectrógrafo à vácuo
- pesquisa em baixas temperaturas
- produção de filmes delgados
- física de superfícies
- pesquisa de plasmas
- equipamento de fusão nuclear
- simulação espacial
- pesquisa de materiais
- preparações para microscopia eletrônica

b) Processos Industriais

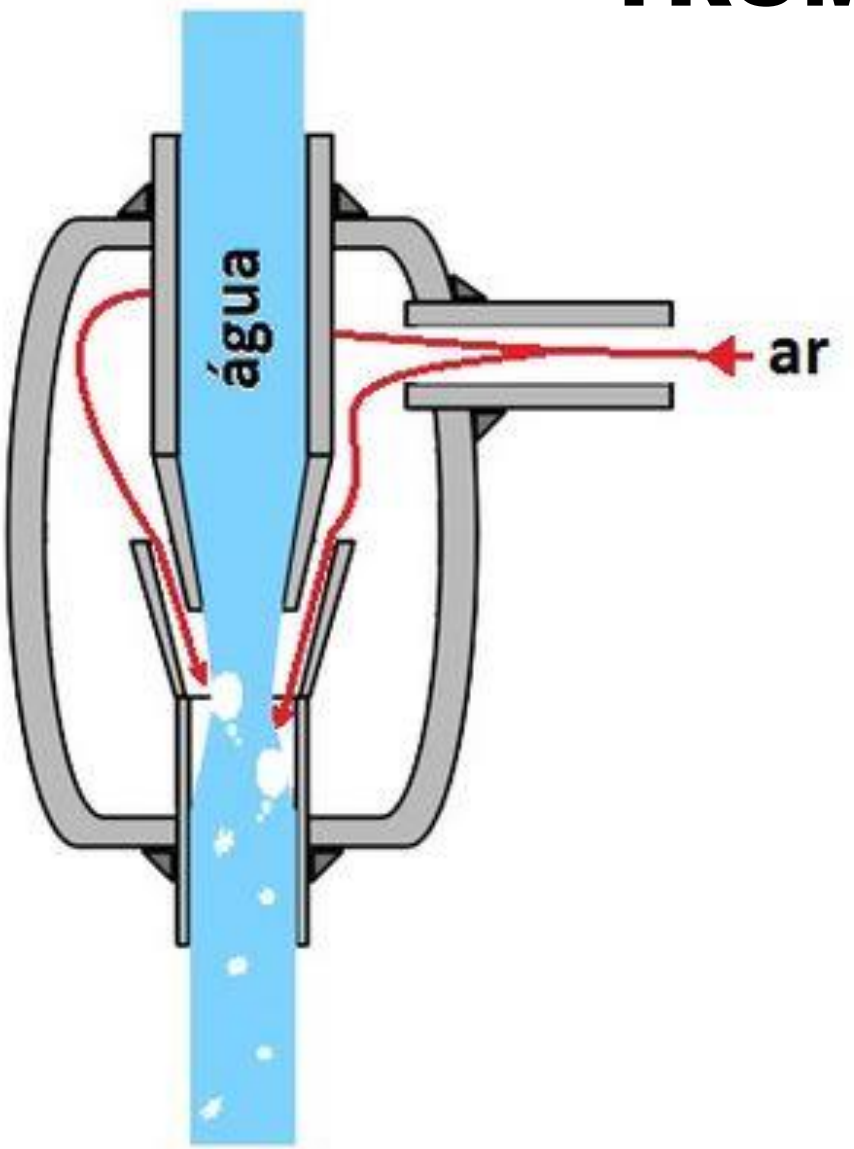



ULTRA-ALTO VÁCUO
ALTO-VÁCUO
PRÉ-VÁCUO
(Torr)
10^-14 10^-13 10^-12 10^-11 10^-10 10^-9 10^-8 10^-7 10^-6 10^-5 10^-4 10^-3 10^-2 10^-1 1 10^1 10^2 10^3
BOMBA DE SORPÇÃO
BOMBA MECÂNICA DE 01 ESTÁGIO
BOMBA MECÂNICA DE 02 ESTÁGIOS
BOMBA ROOTS
BOMBA DE DIFUSÃO
BOMBA TURBO-MOLECULAR
BOMBA DE SUBLIMAÇÃO
BOMBA IÔNICA (ORBITRON)
BOMBA IÔNICA (SPUTTER-ION)
BOMBA CRIOGÊNICA

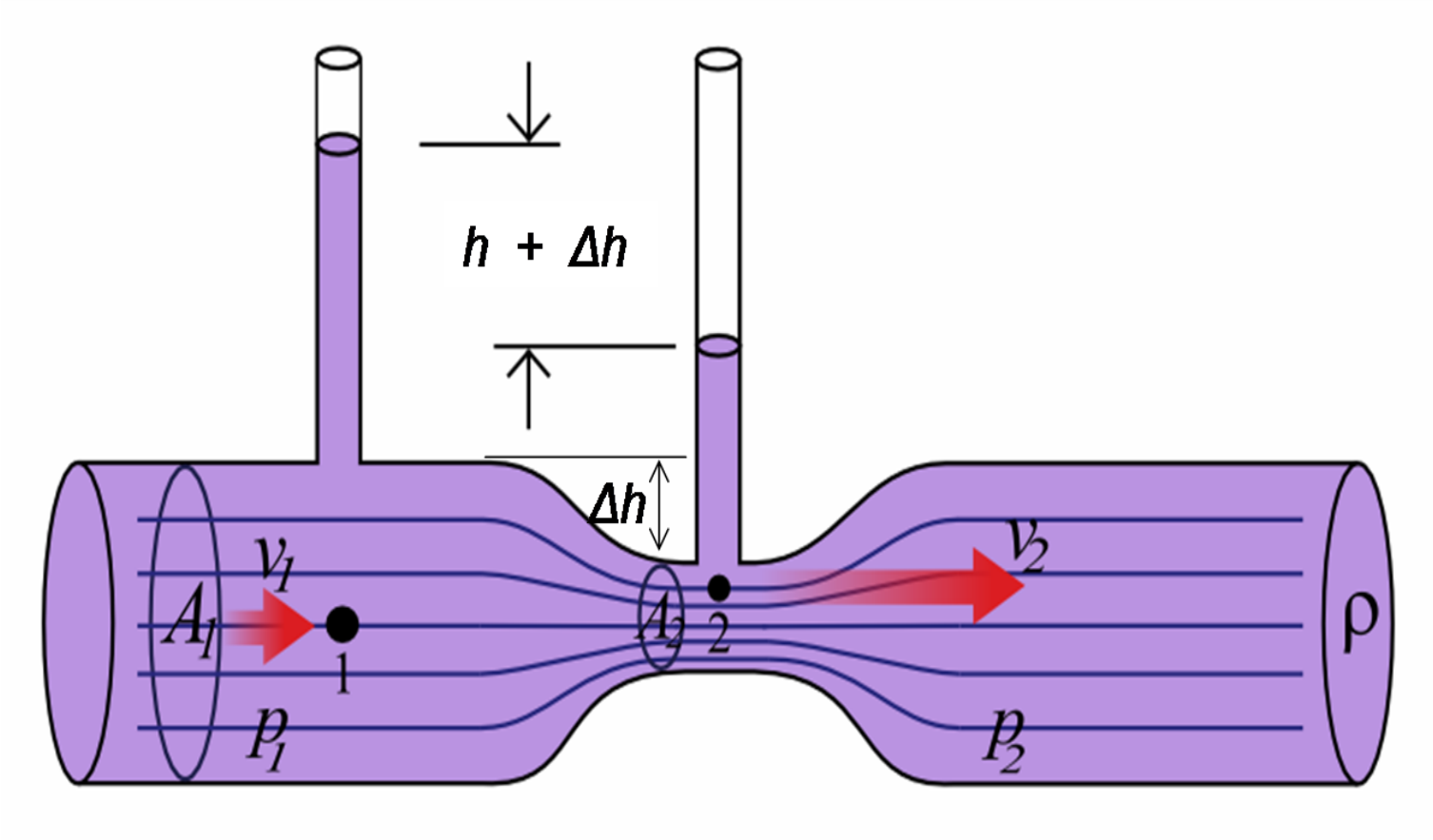
TROMPA DE VÁCUO

Fonte: Groups

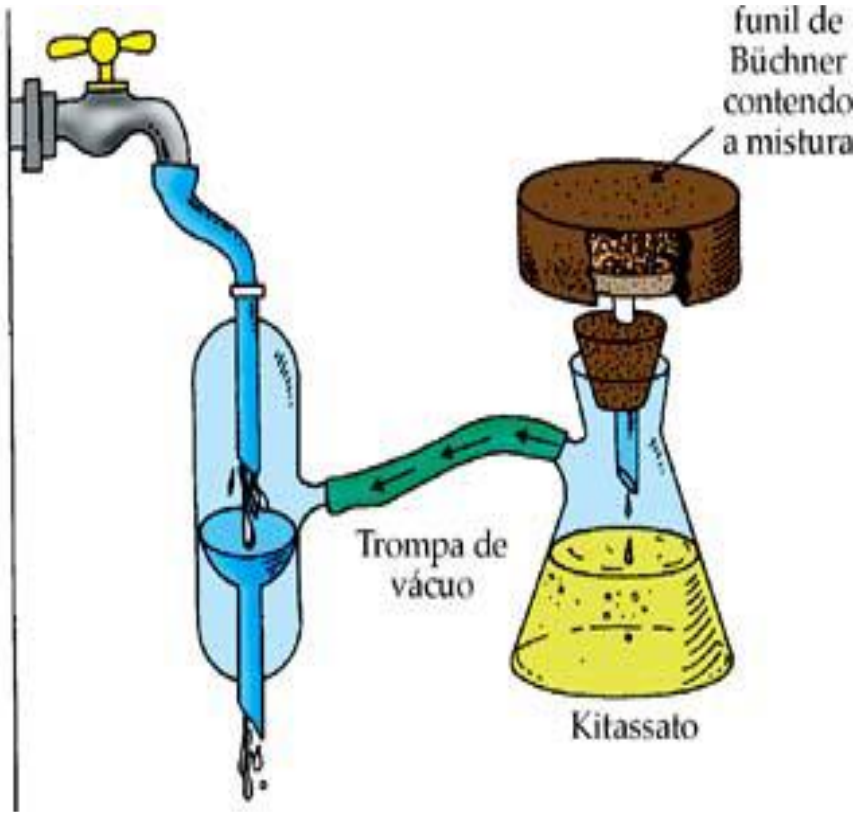
TROMPA DE VÁCUO



TUBO DE VENTURI



FILTRAÇÃO A VÁCUO

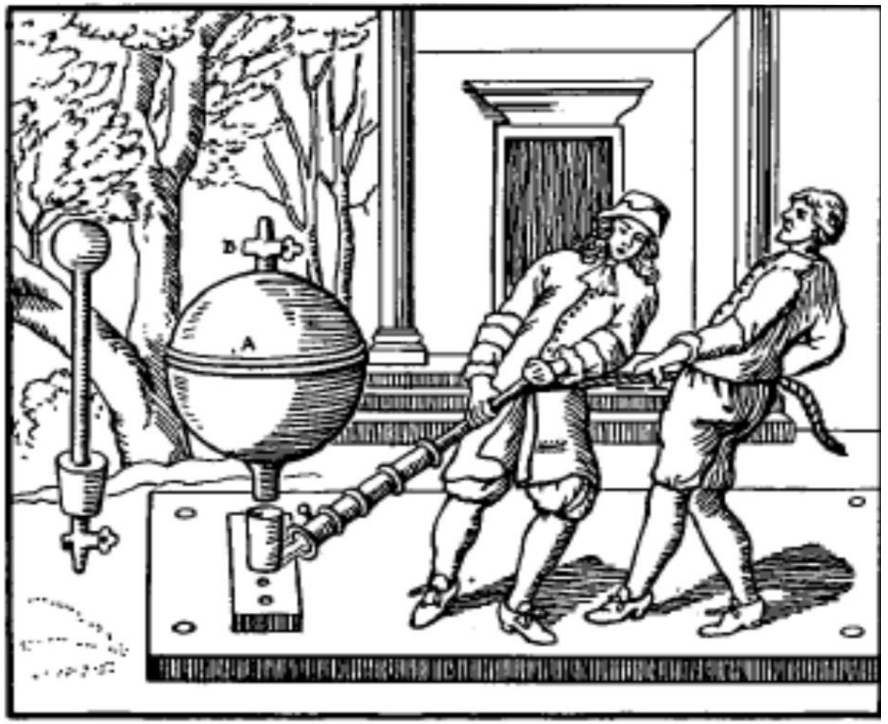


BOMBAS A PISTÃO

Primeiros modelos de

Otto von Guericke

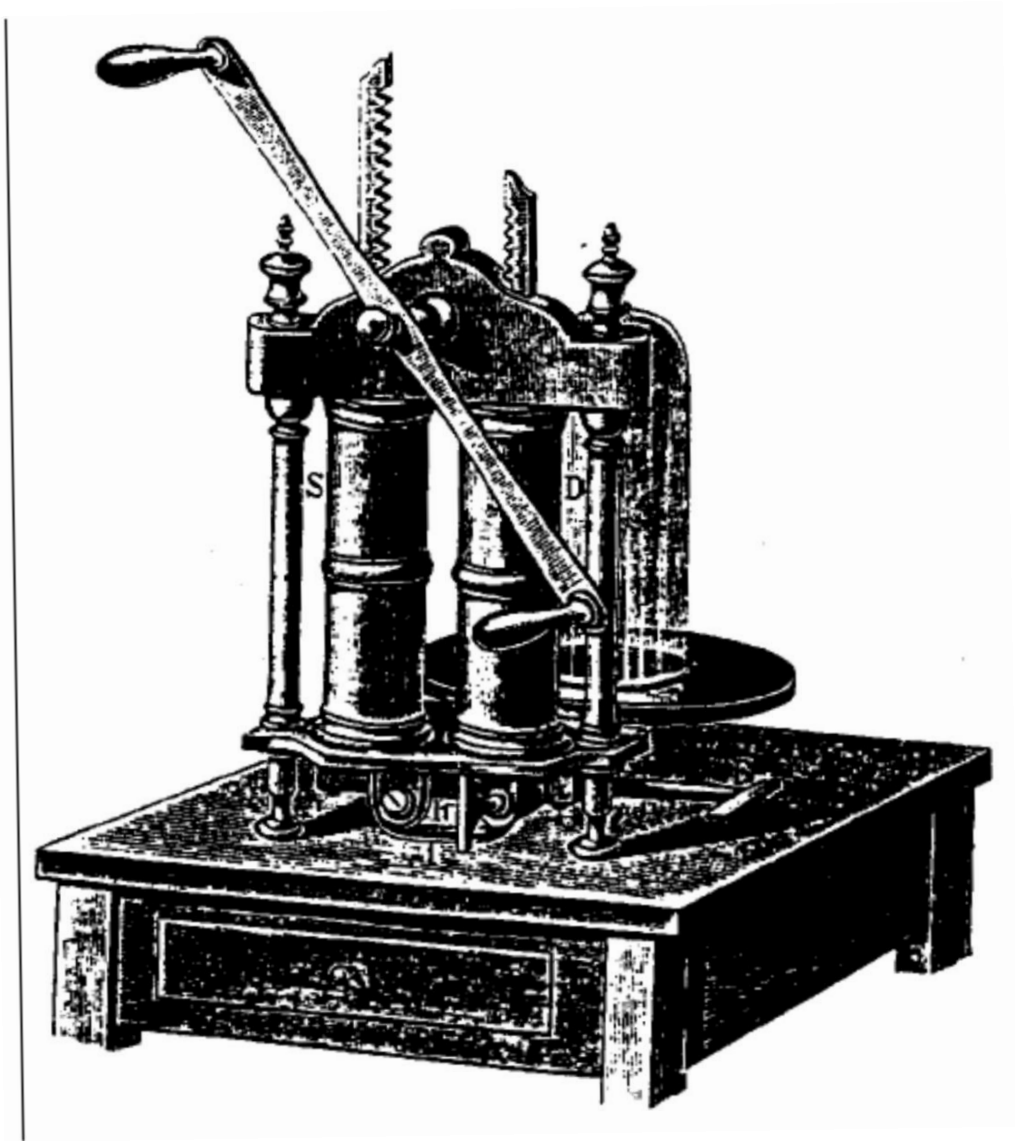
1640

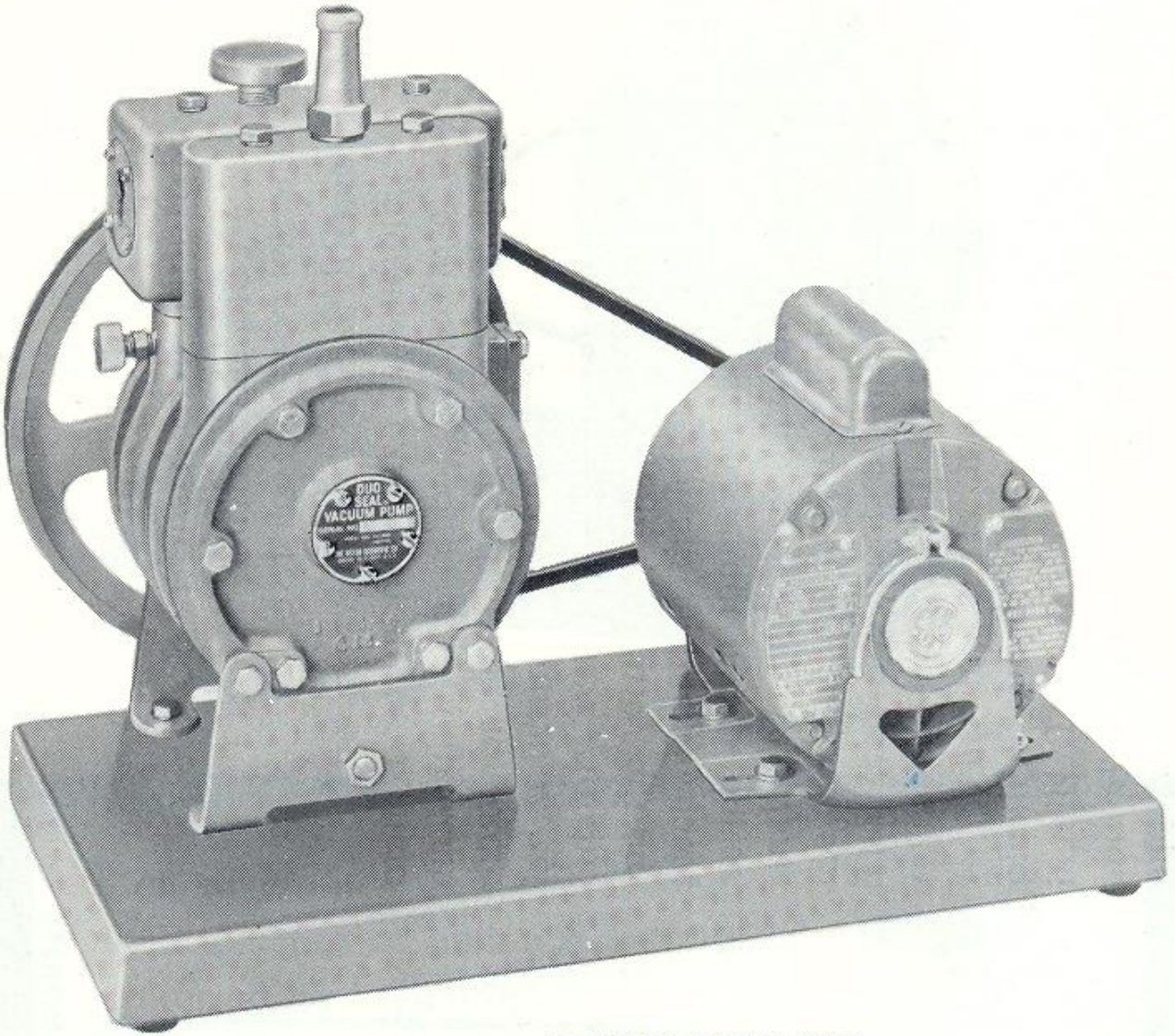


BOMBA DE 2 PISTÕES

Modelo comercial

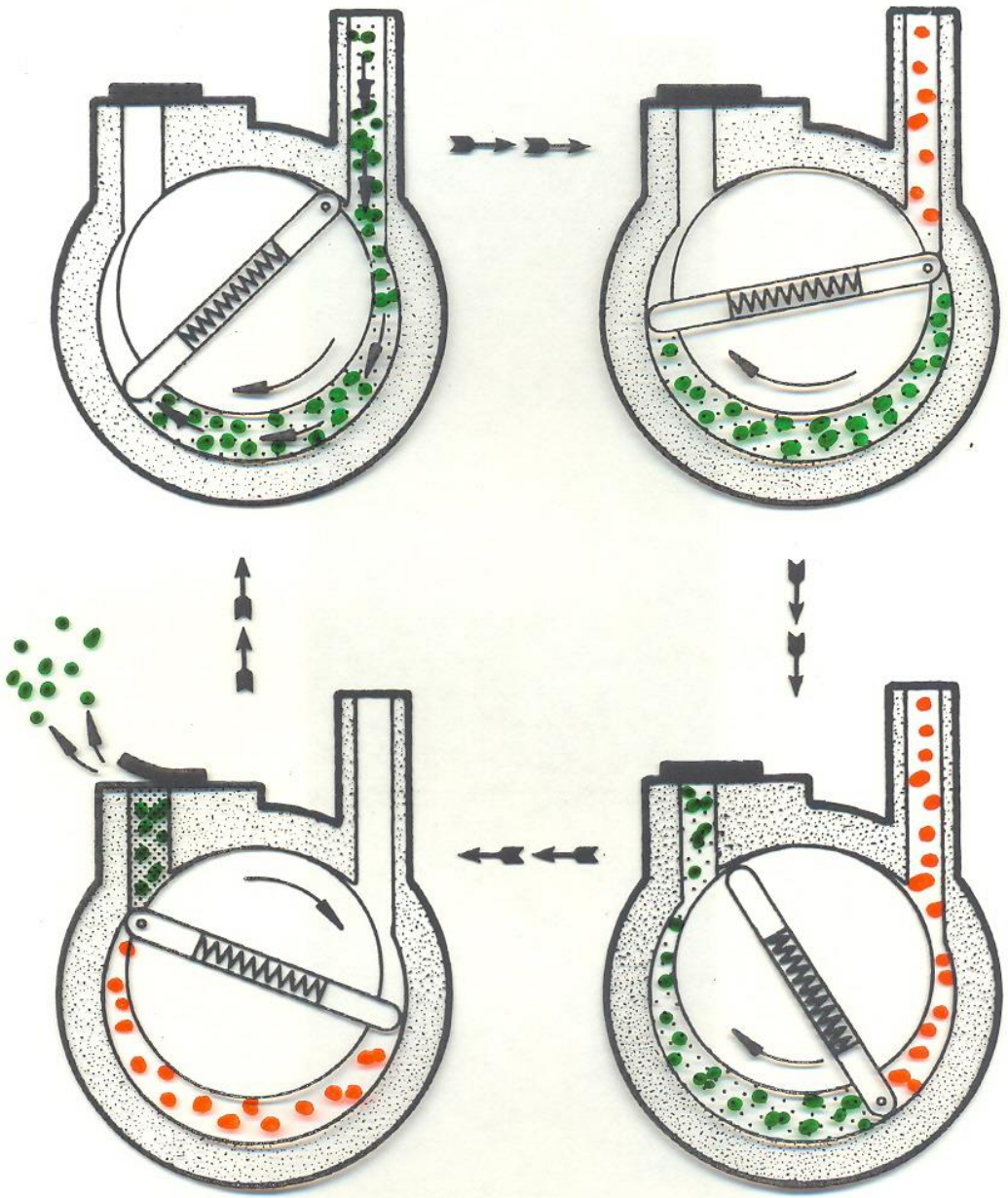
1850





TWO-STAGE

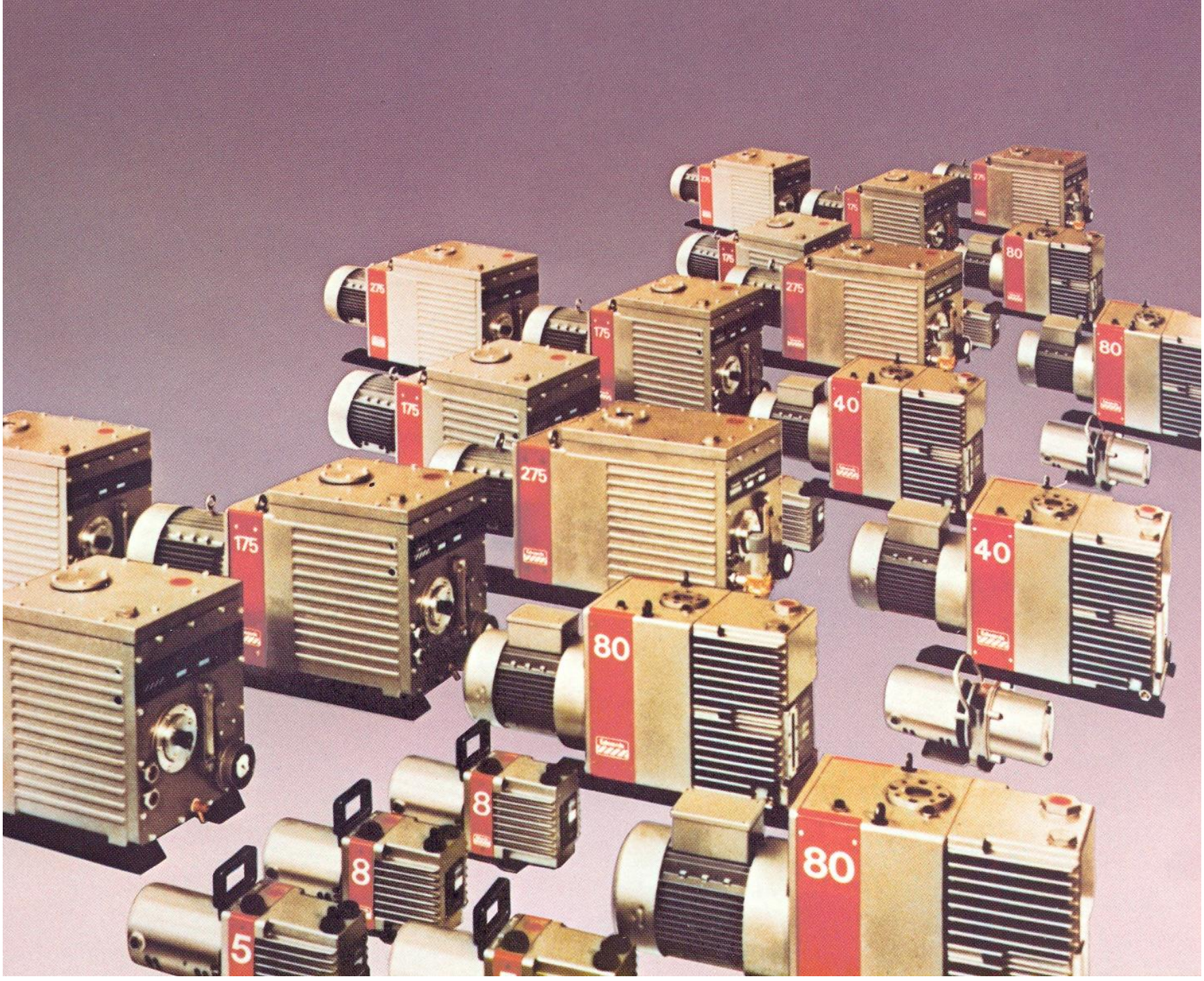
PATENTED

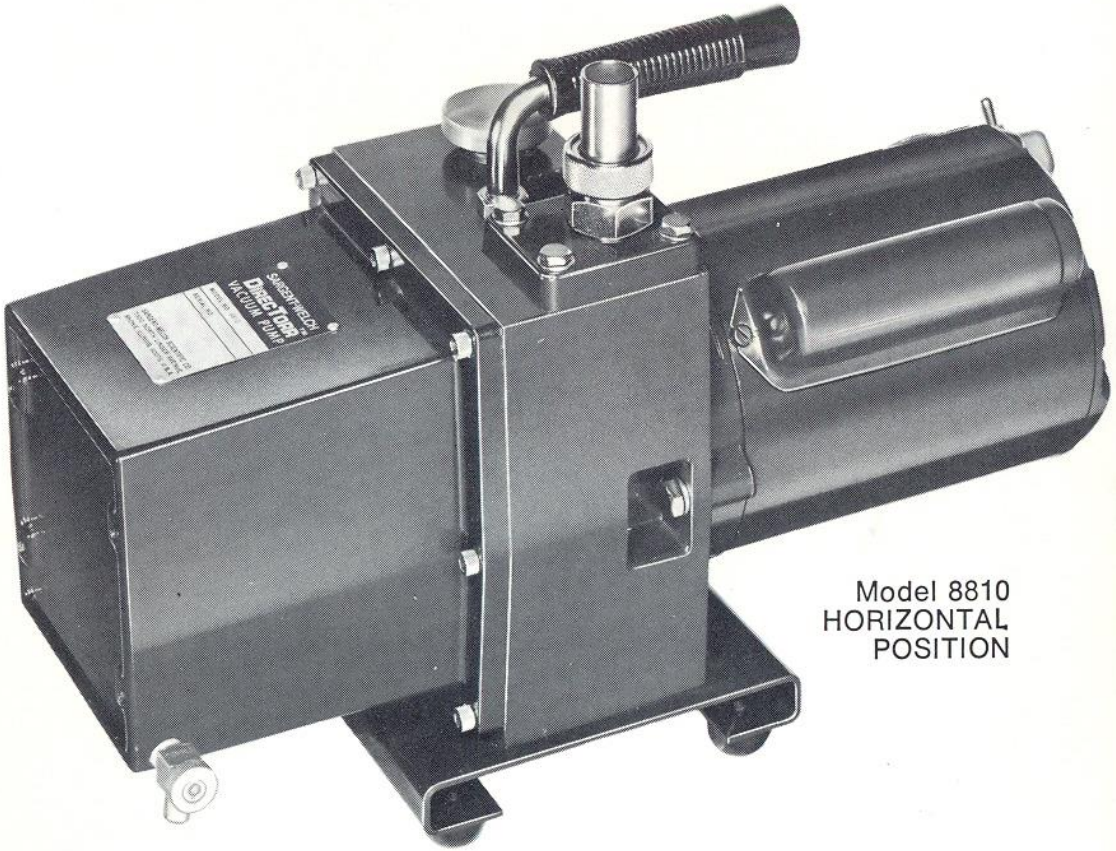


IFUSP - DFN


PRECISION
VACUUM PUMP
MODEL DD90

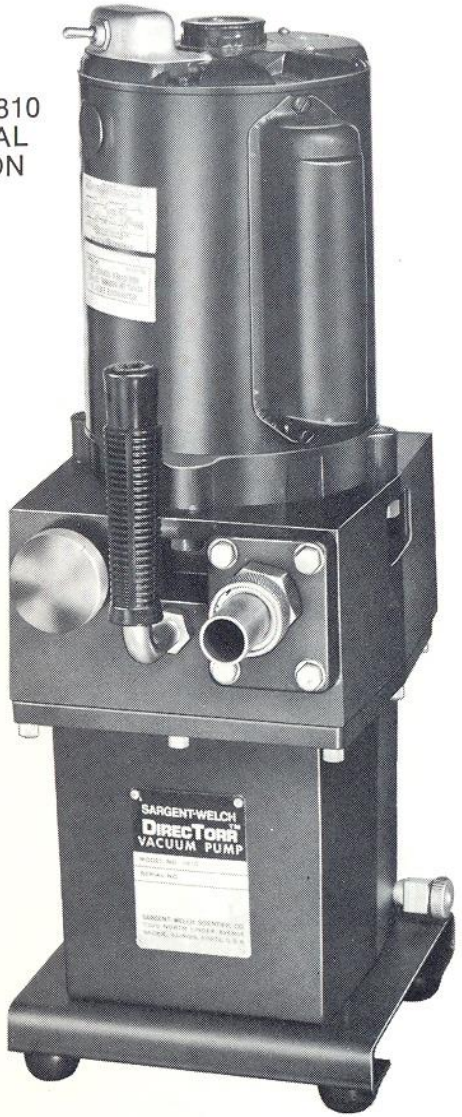

5
Two Stage
Edwards
WEG

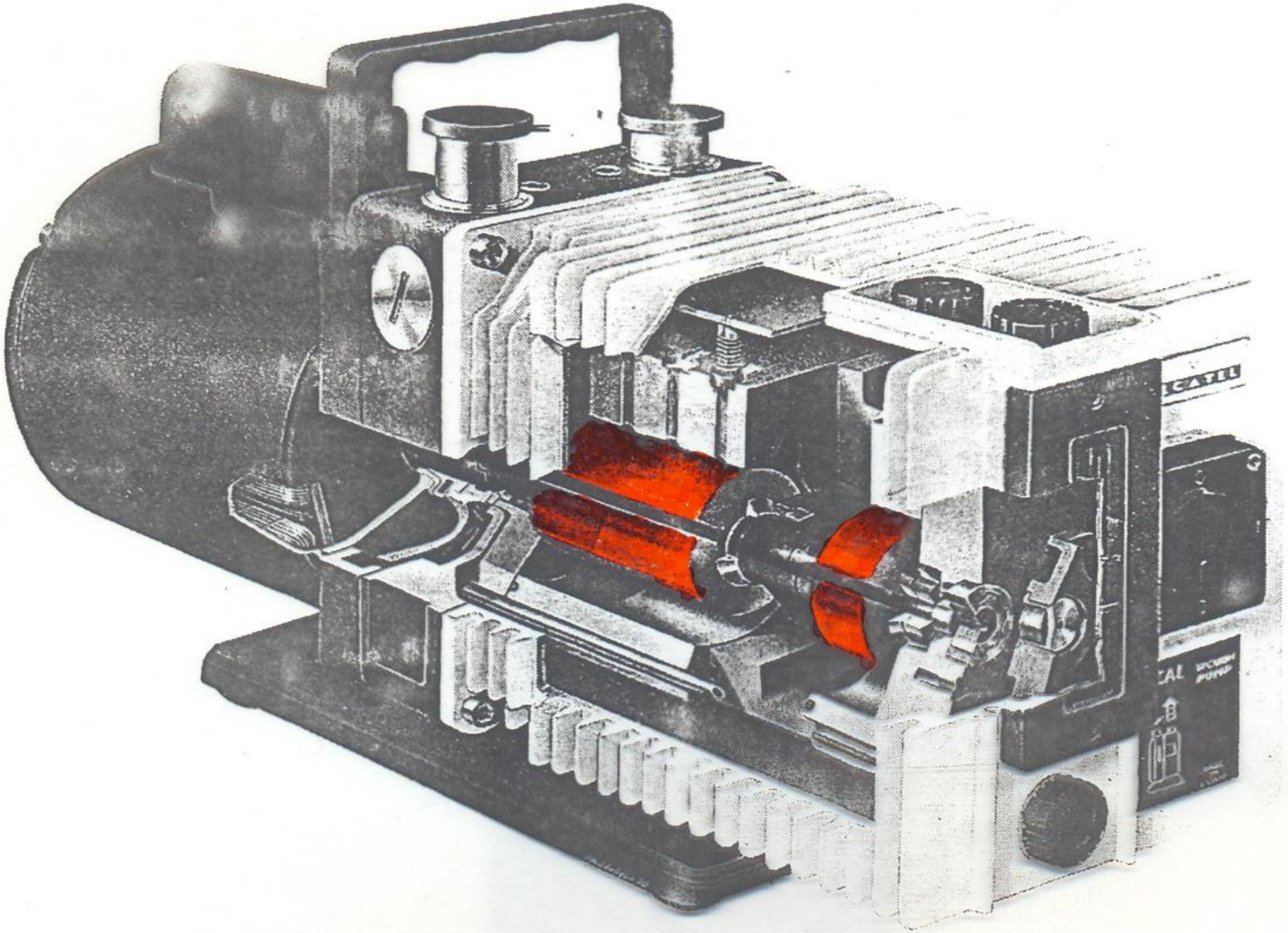

275
175
80
40
8
5



Model 8810
HORIZONTAL
POSITION

Model 8810
VERTICAL
POSITION





SEM GAS BALLAST

a_1

b_1

a_2

b_2

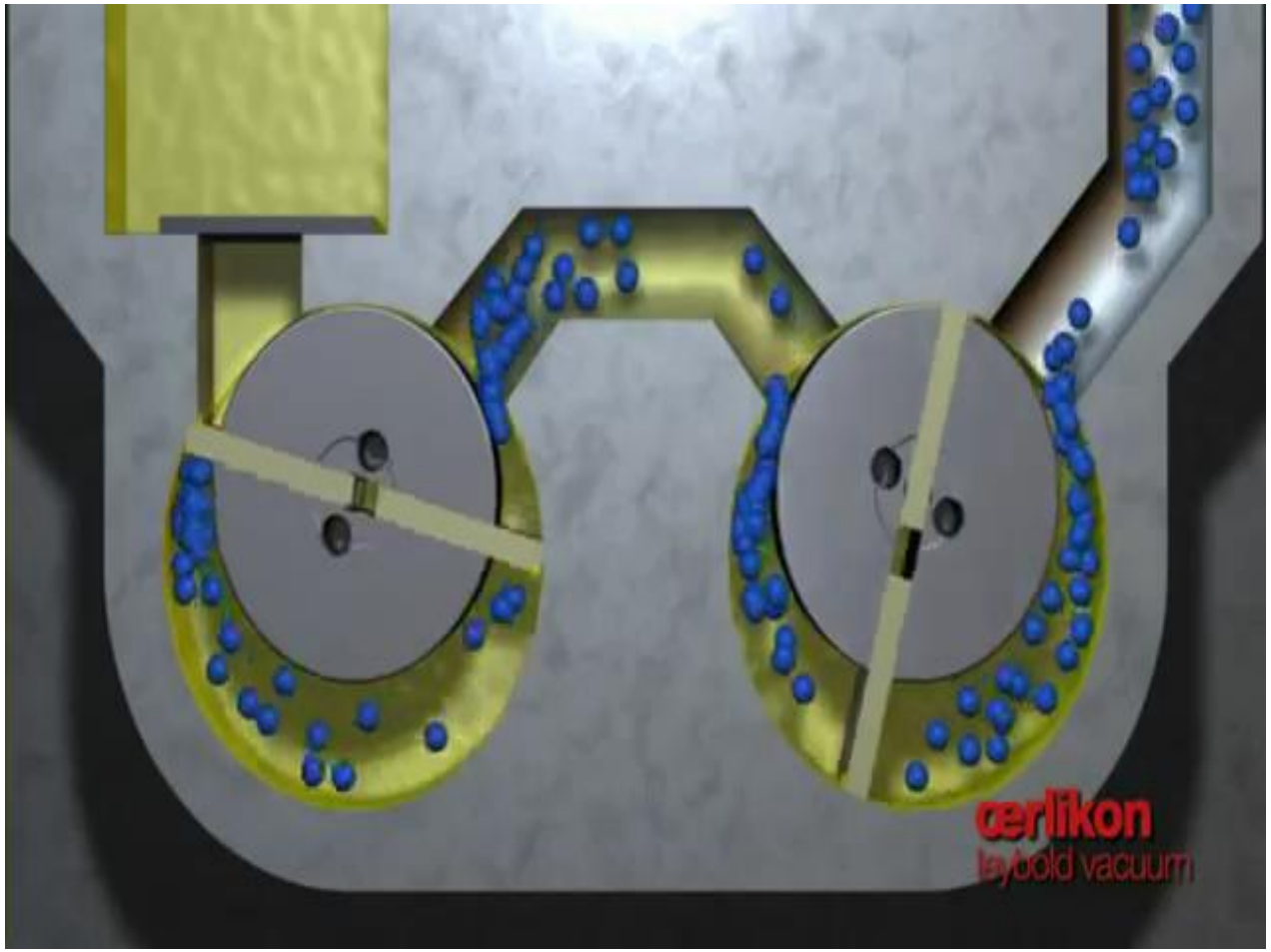
a_3

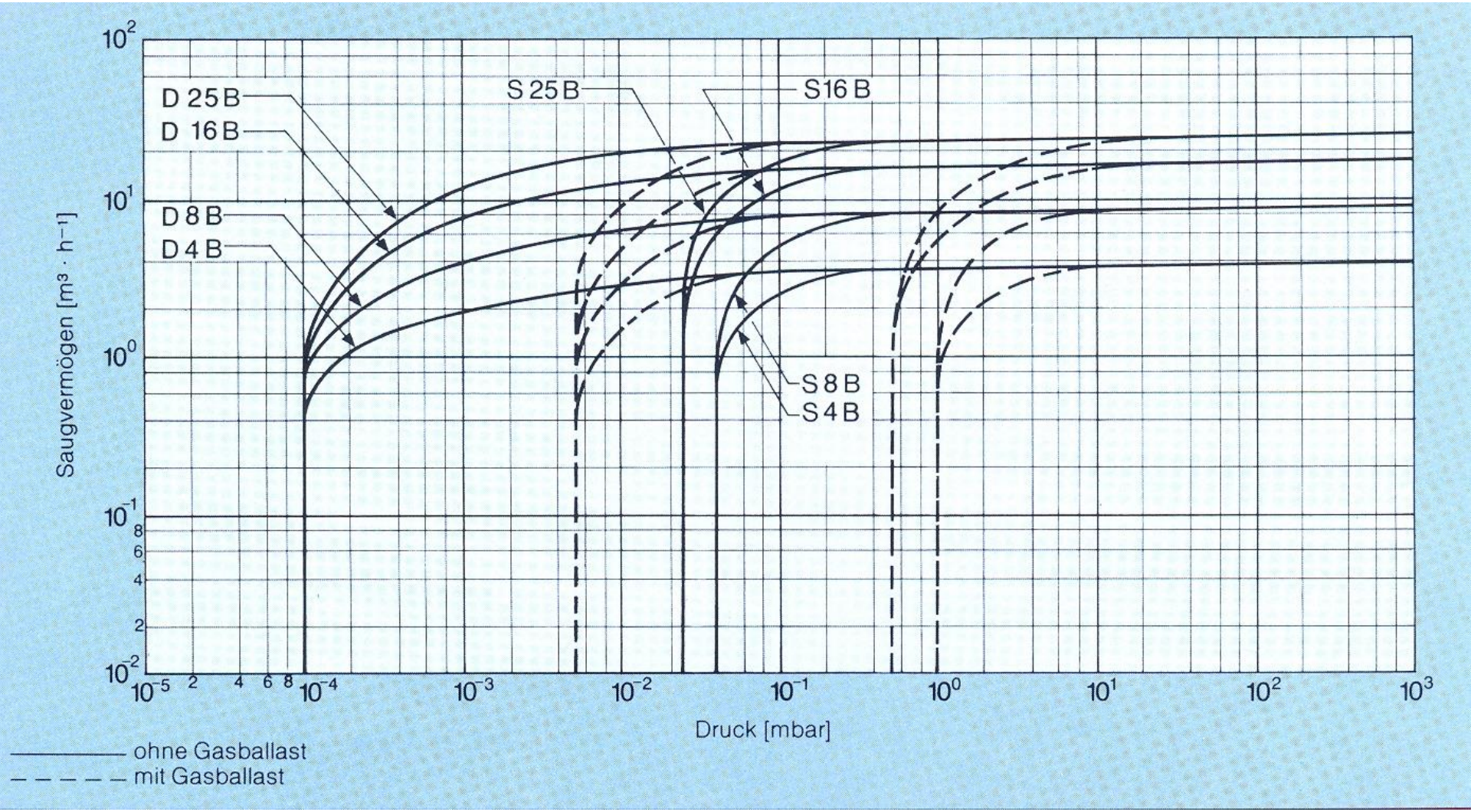
b_3

a_4

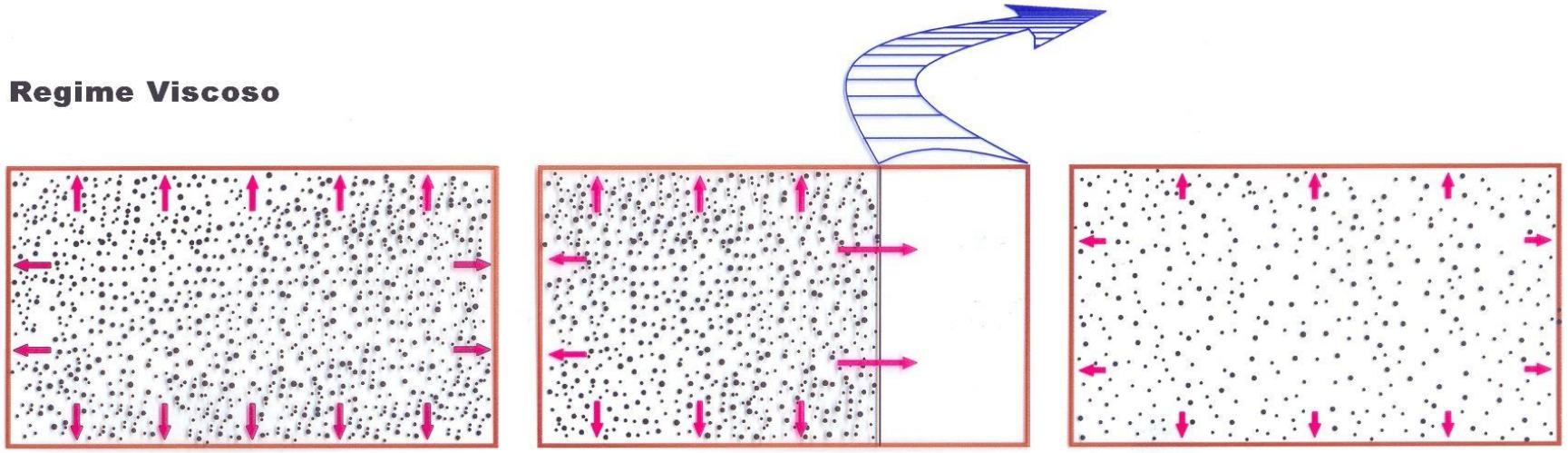
b_4

COM GAS BALLAST

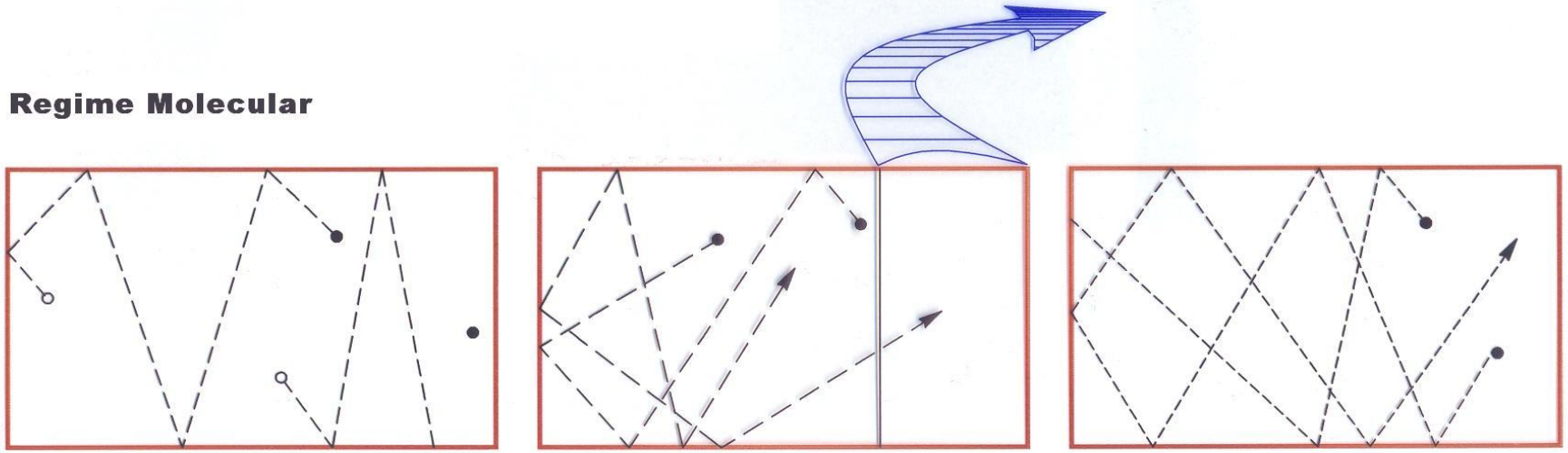

oerlikon
leybold vacuum

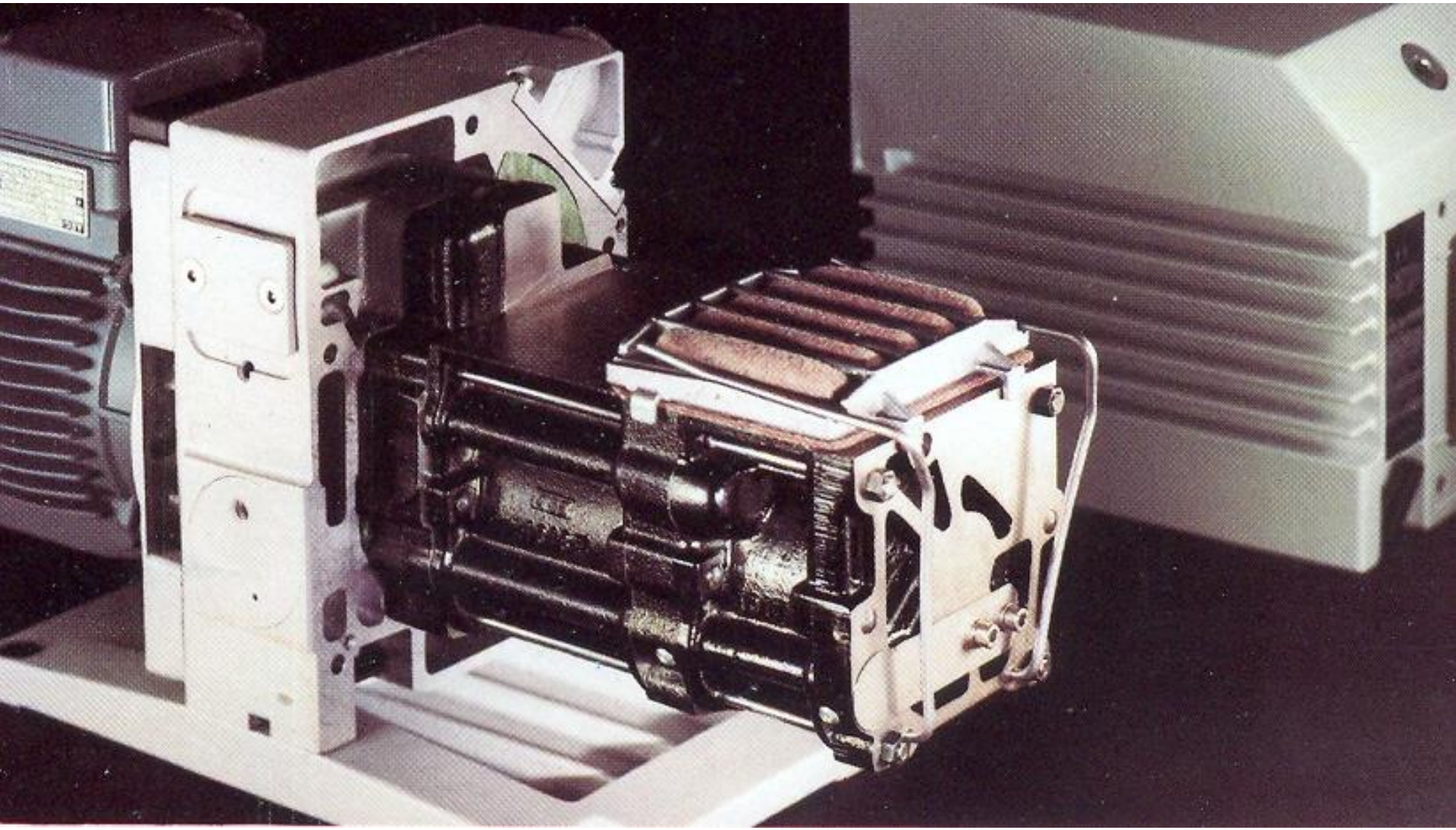

D 25 B
D 16 B
D 8 B
D 4 B
S 25 B
S16 B
S 8 B
S 4 B
Saugvermögen [m³ · h⁻¹]
Druck [mbar]
ohne Gasballast
mit Gasballast

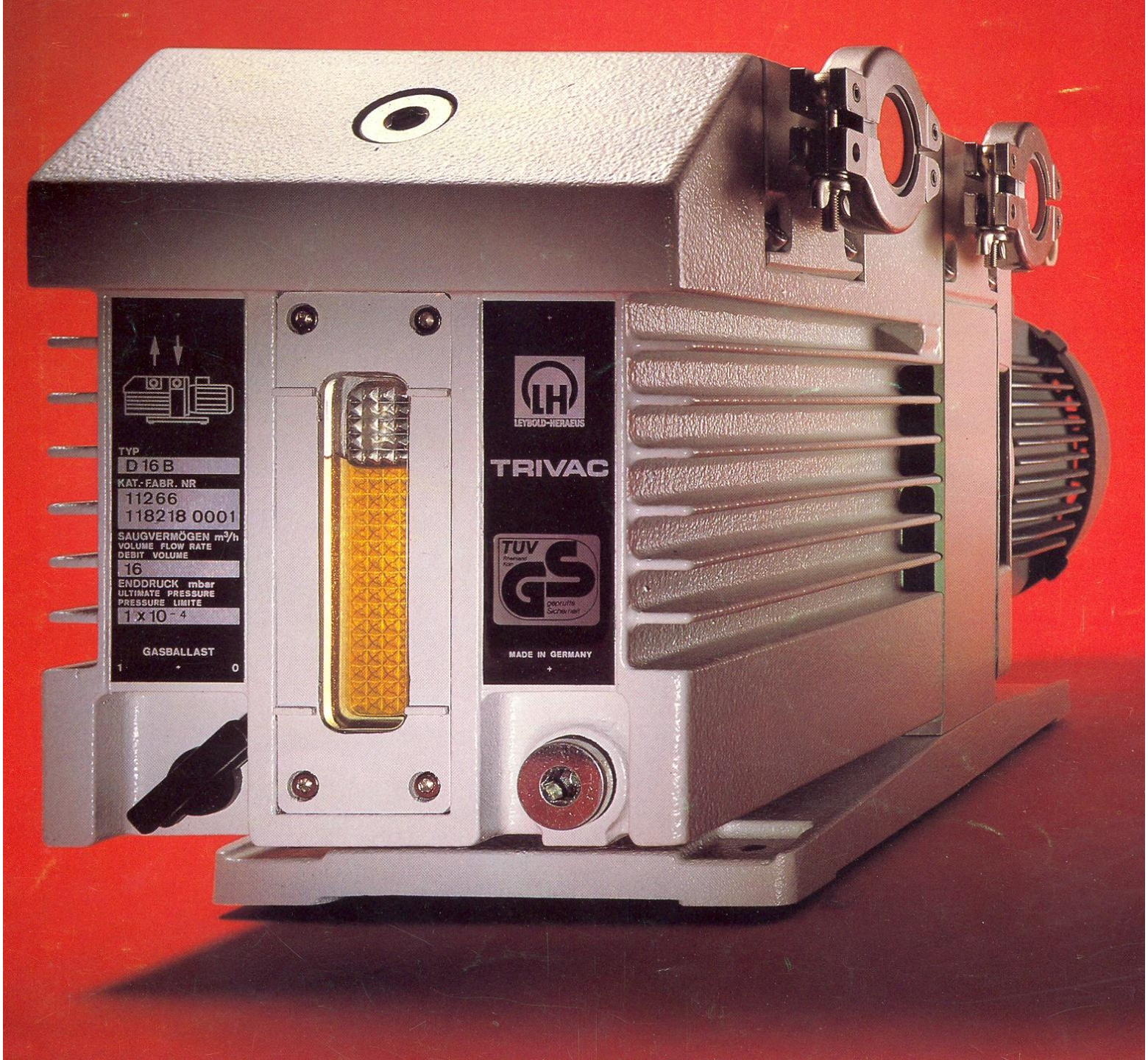
Regime Viscoso



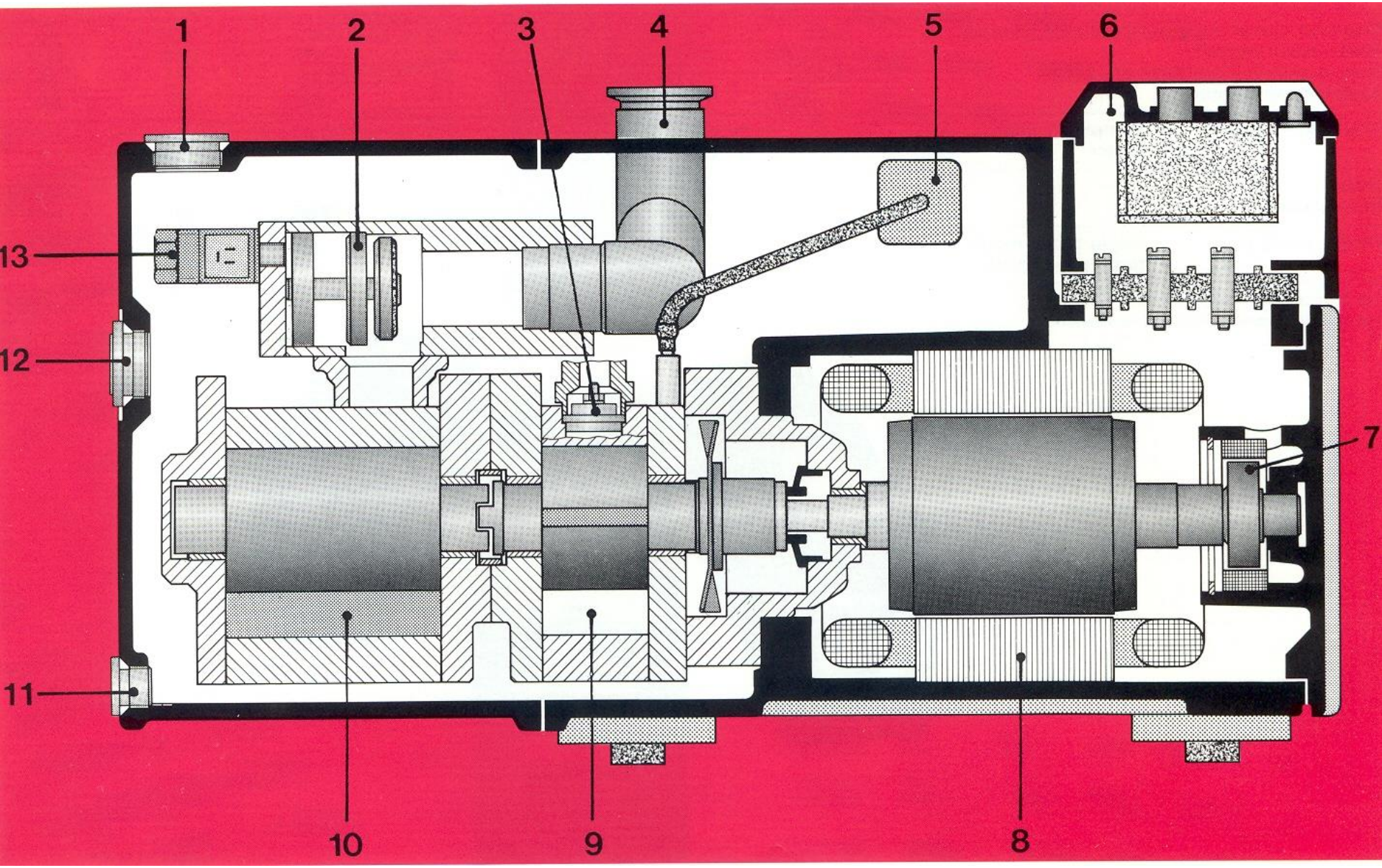
Regime Molecular






TYP
D 16 B
KAT.-FABR. NR
11266
118218 0001
SAUGVERMÖGEN m³/h
VOLUME FLOW RATE
DEBIT VOLUME
16
ENDDRUCK mbar
ULTIMATE PRESSURE
PRESSURE LIMITE
1 x 10⁻⁴
GASBALLAST
1 0
LEYBOLD-HERAEUS
TRIVAC
TÜV
GS
MADE IN GERMANY


PFEIFFER
Ein Unternehmen der Gruppe
BALZERS
DUO 016 B
PKD 44204/ D044
1 · 10⁻⁴
BZ 43
0,55
50
1
220—240
2,2 — 2,4
P 3
1,1
1,5


1
2
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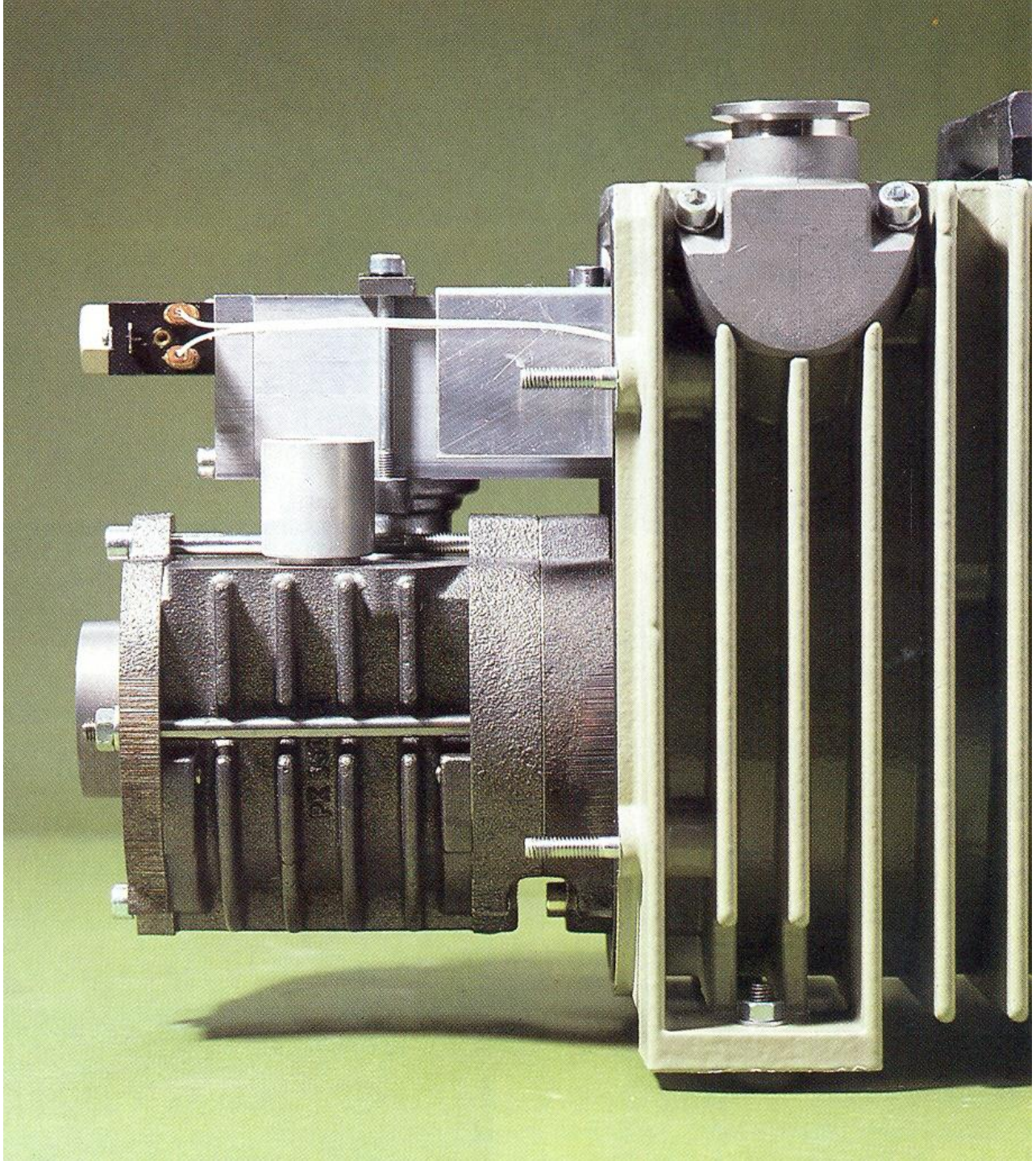
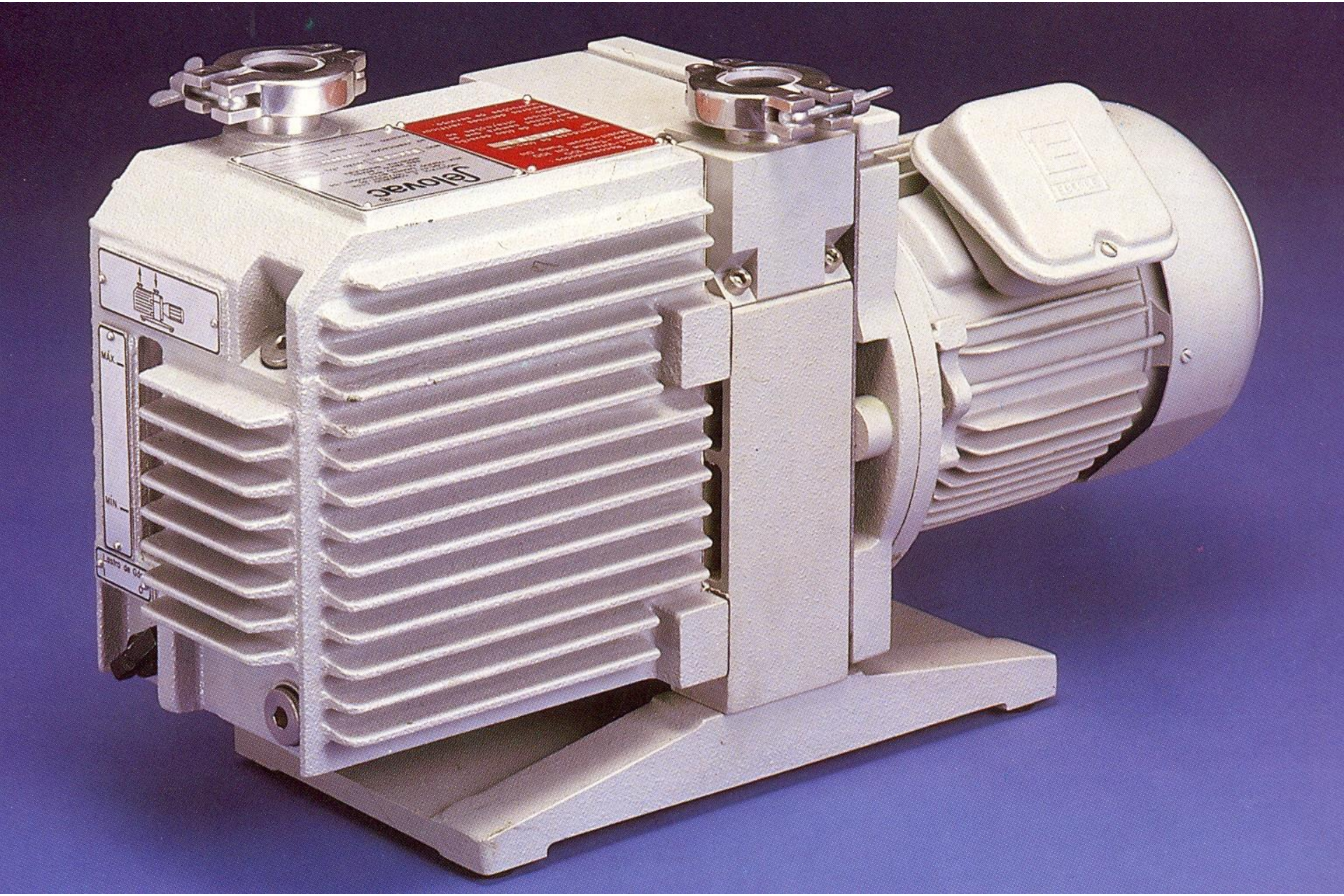
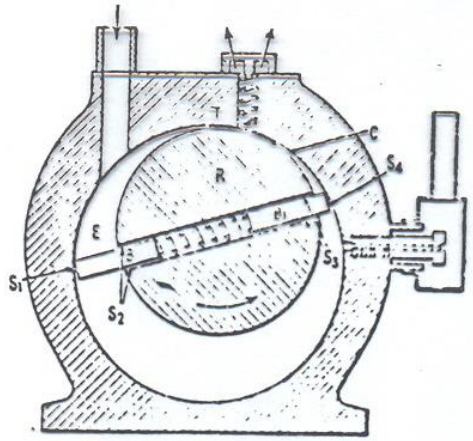
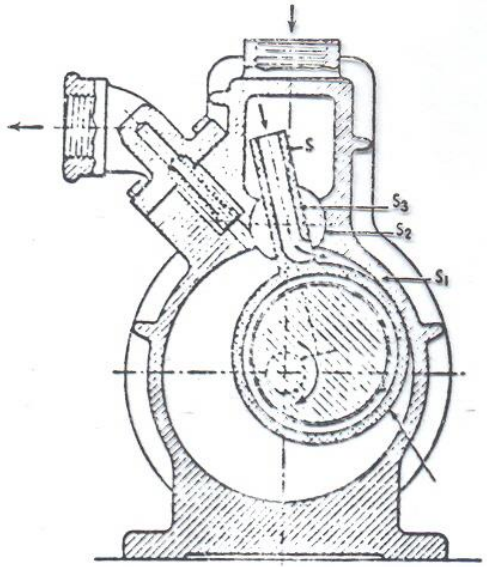
12
13



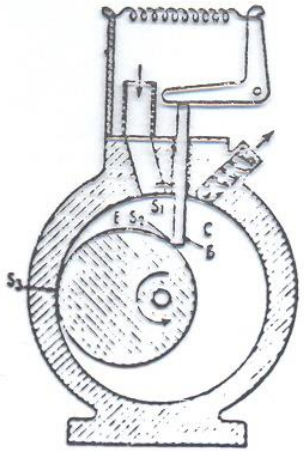

Alcatel
MAX.
MIN.



Bomba de palhetas desenvolvida por Gaede

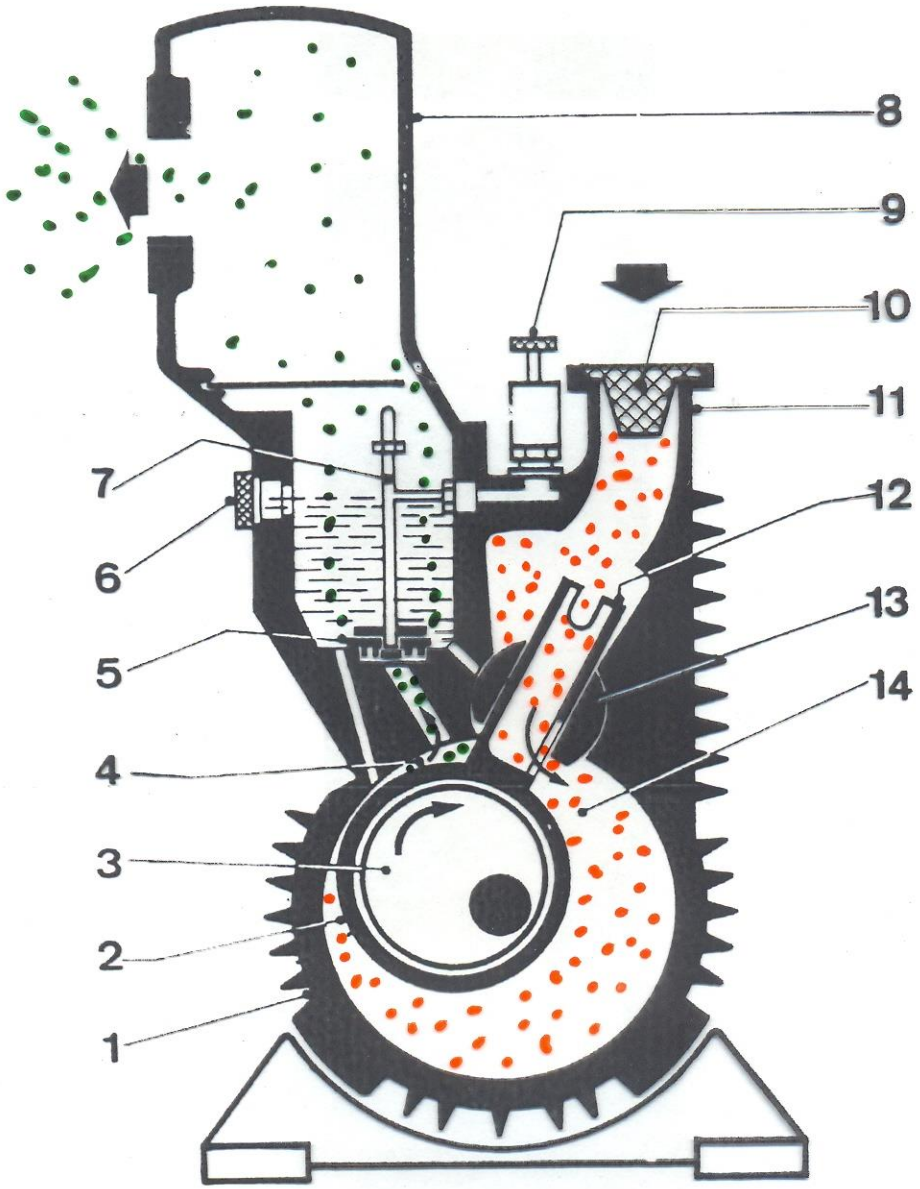


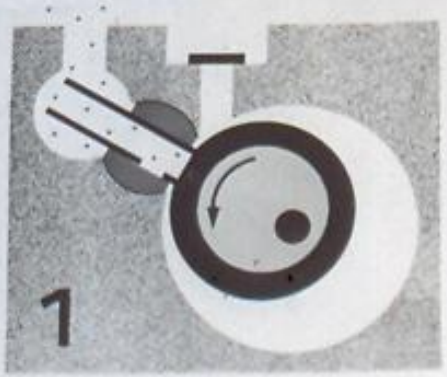
Modelo de pistão oscilante de Kinney



Bomba de uma só palheta da Cenco

BOMBA DE PISTÃO OSCILANTE (KINNEY)

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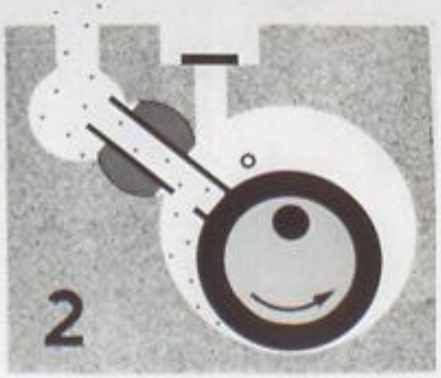
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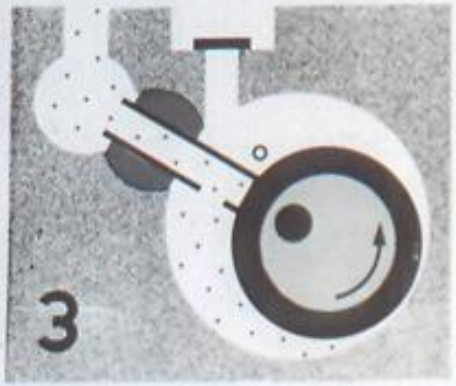
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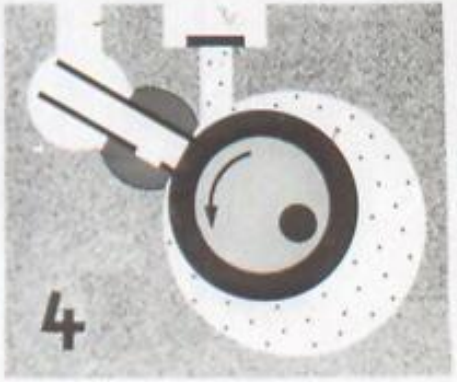
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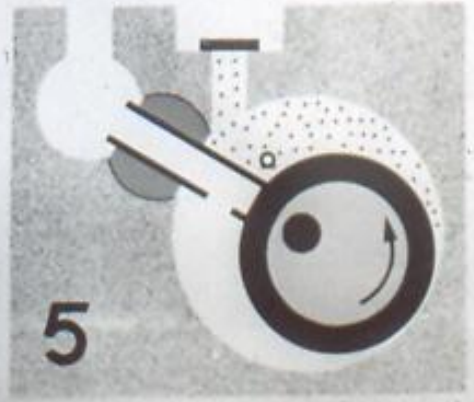
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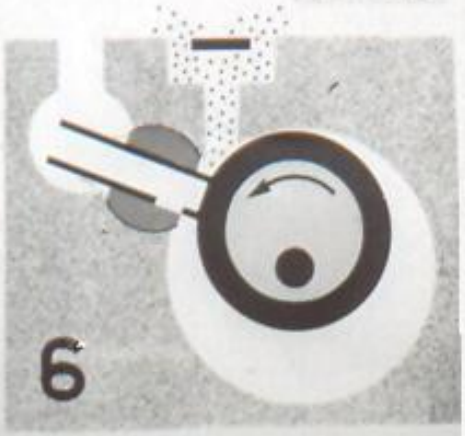
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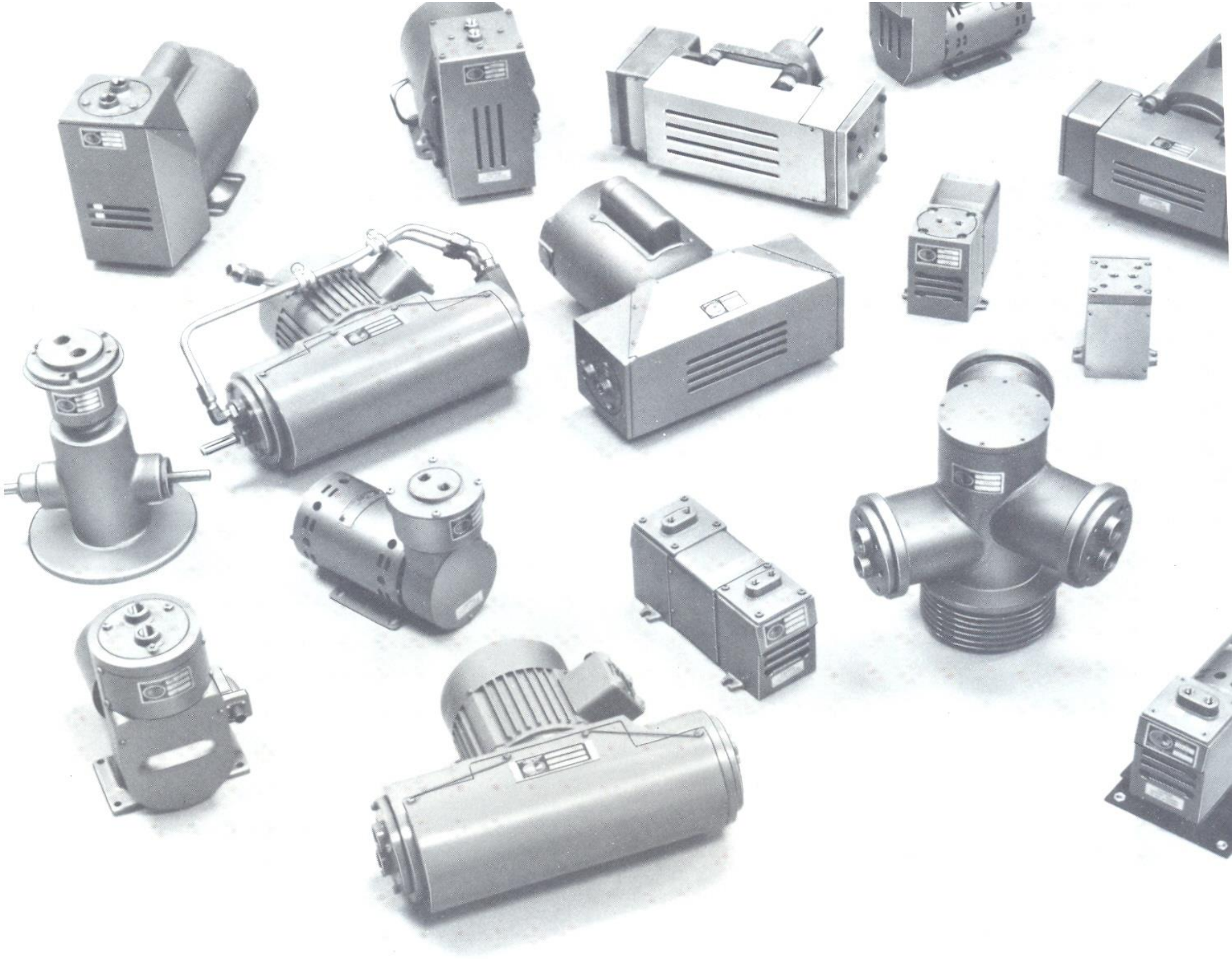
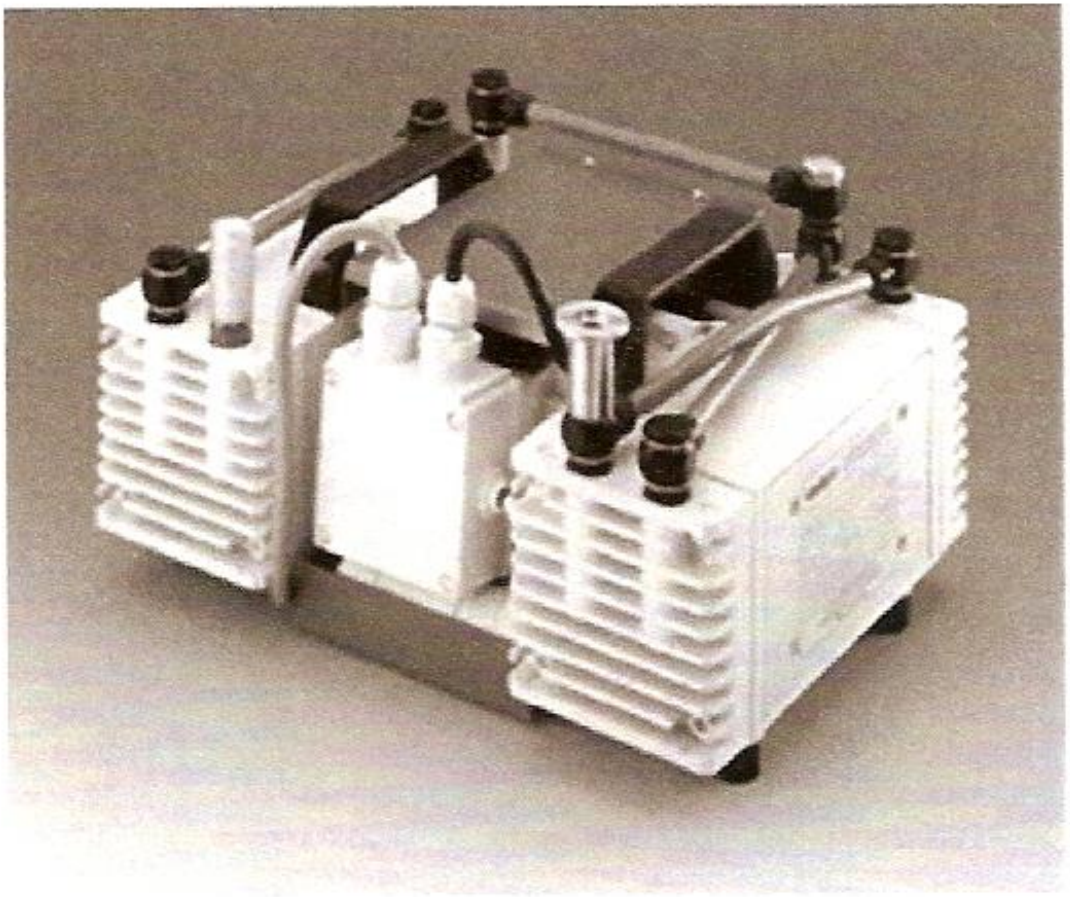
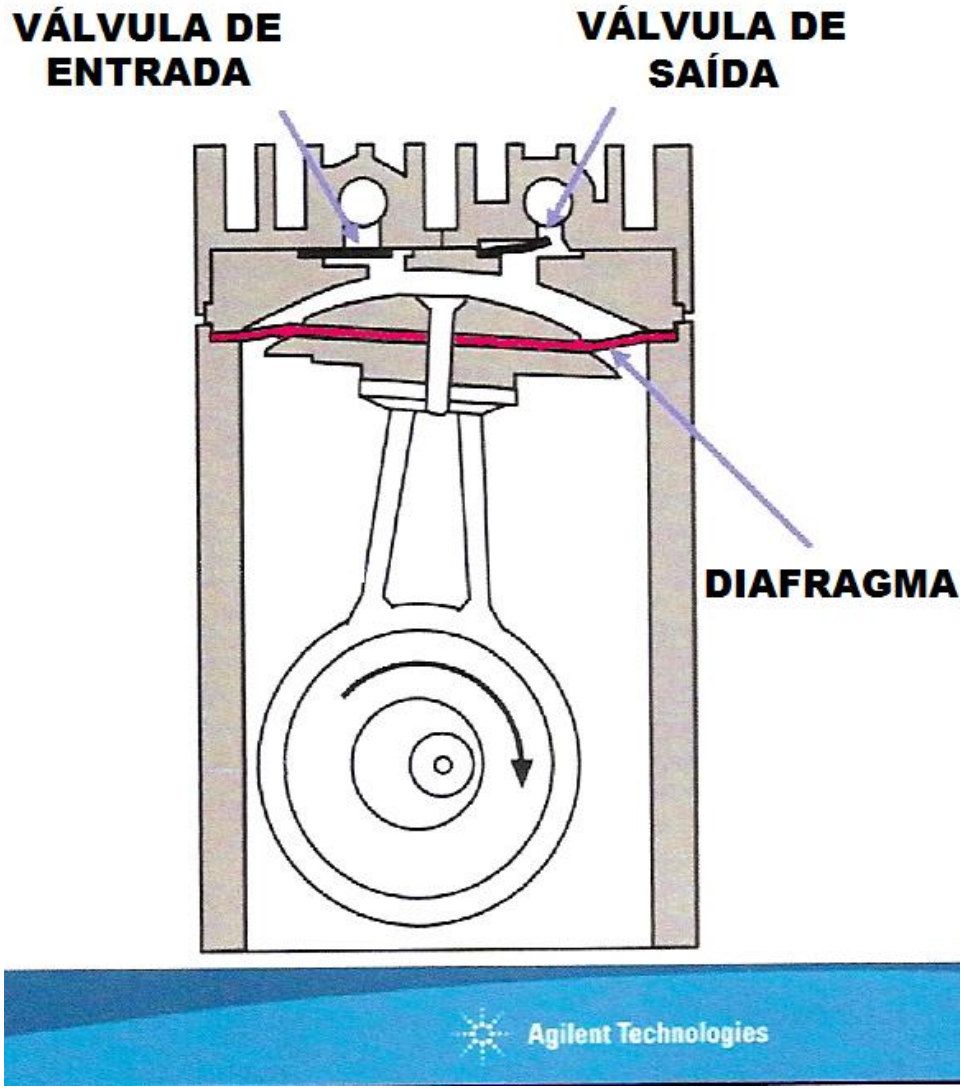


BOMBA DE DIAFRAGMA

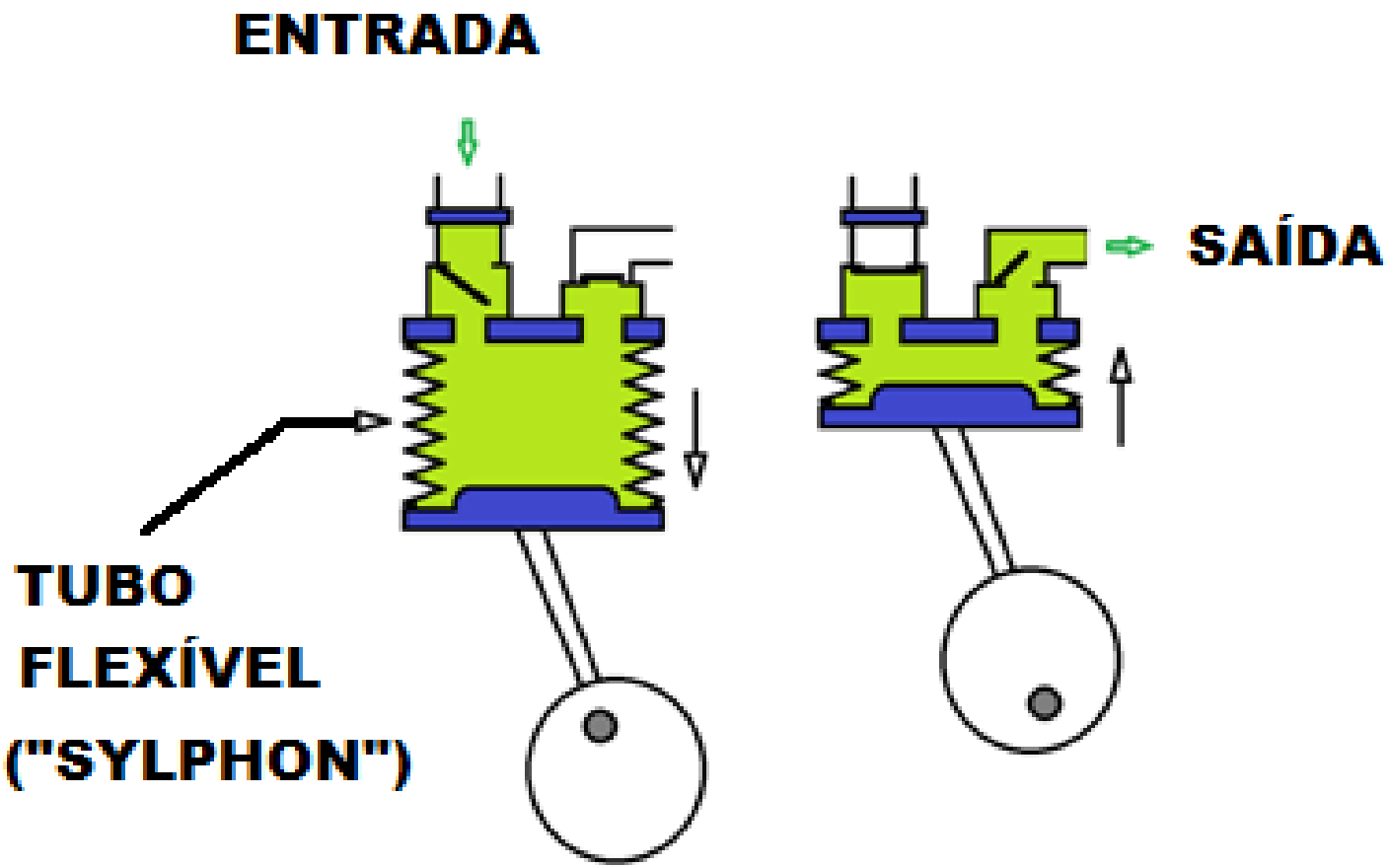


Agilent Technologies

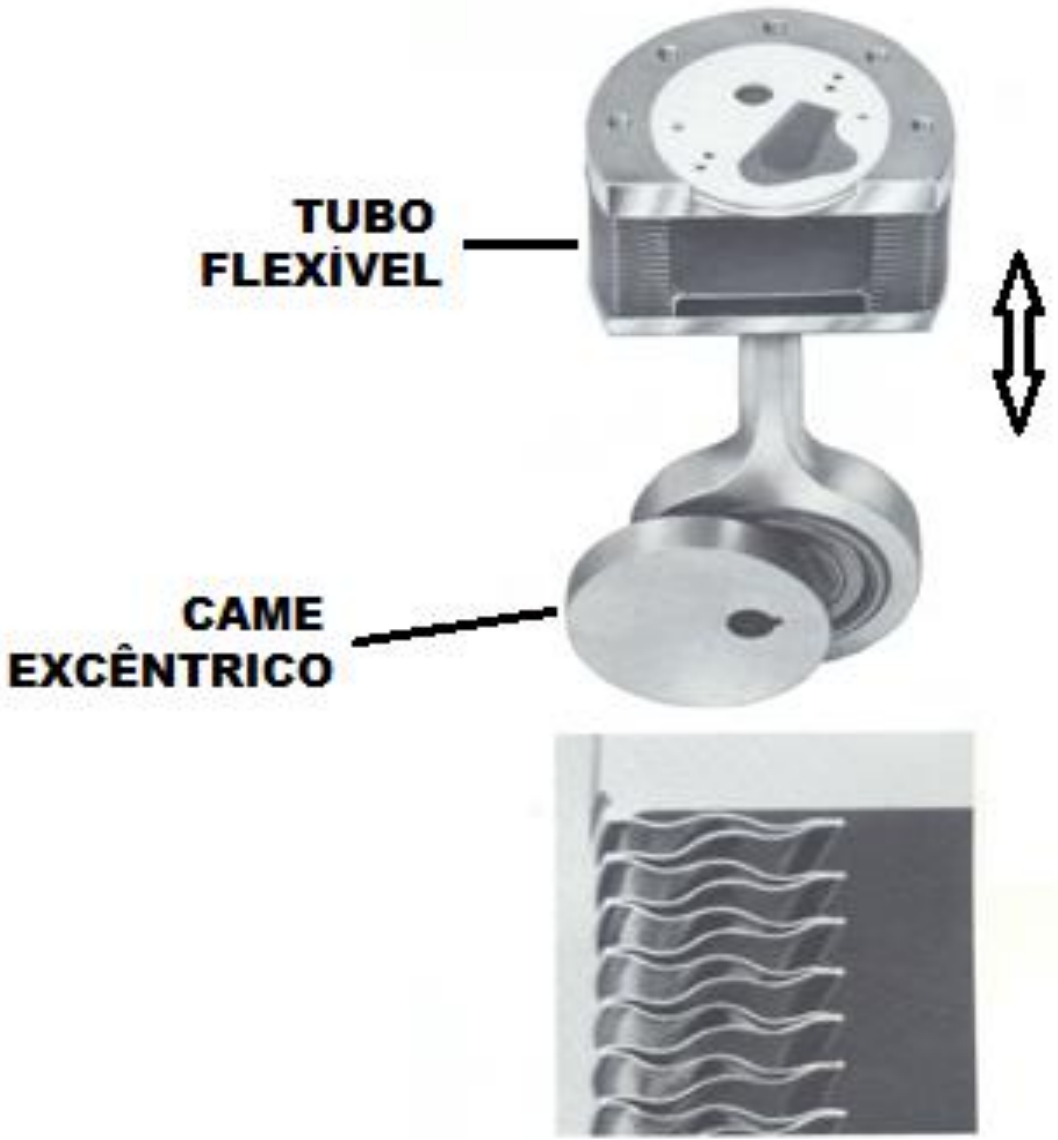
BOMBA DE DIAFRAGMA



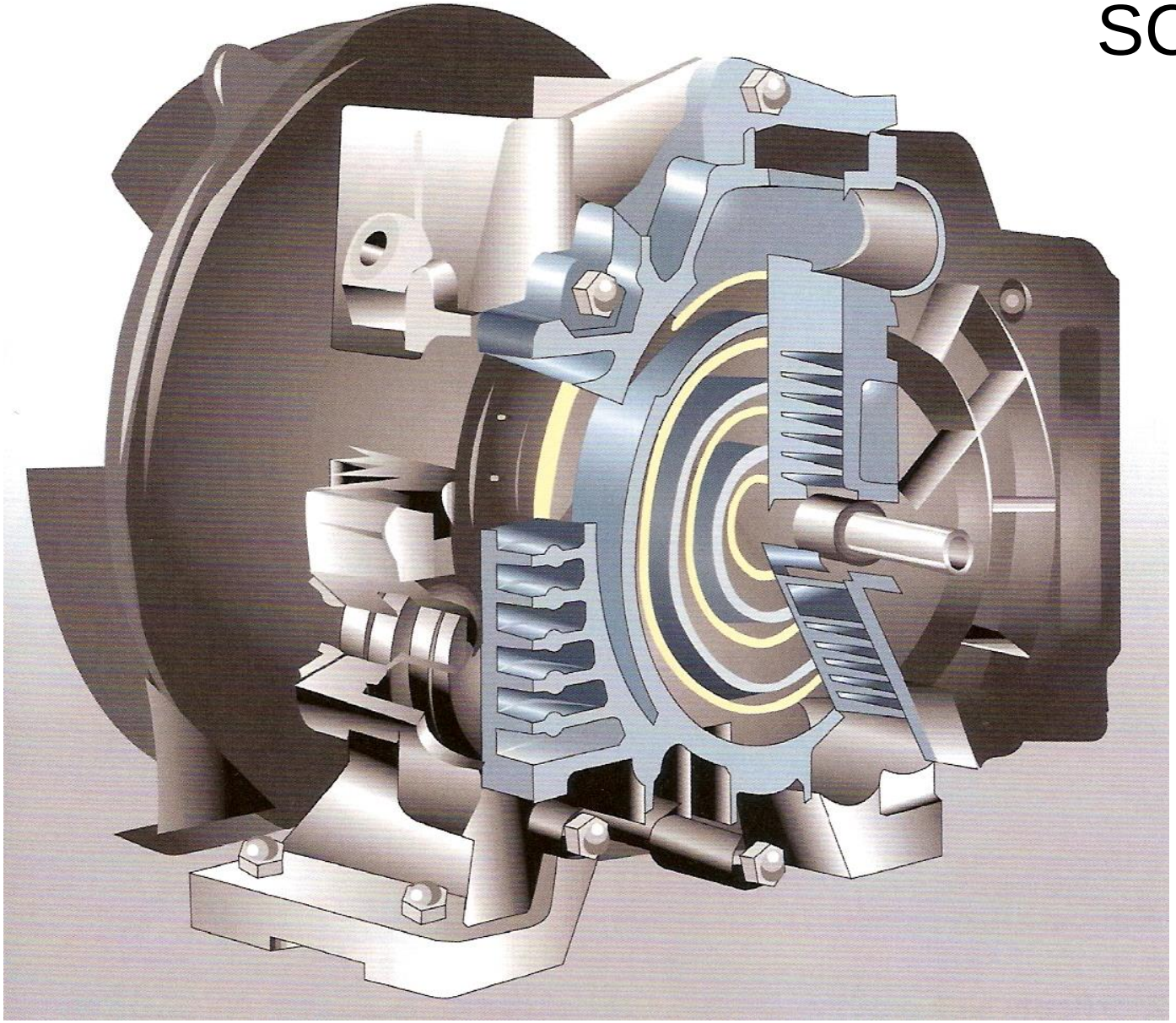
BOMBA MECÂNICA SECA ("DRY PUMP")



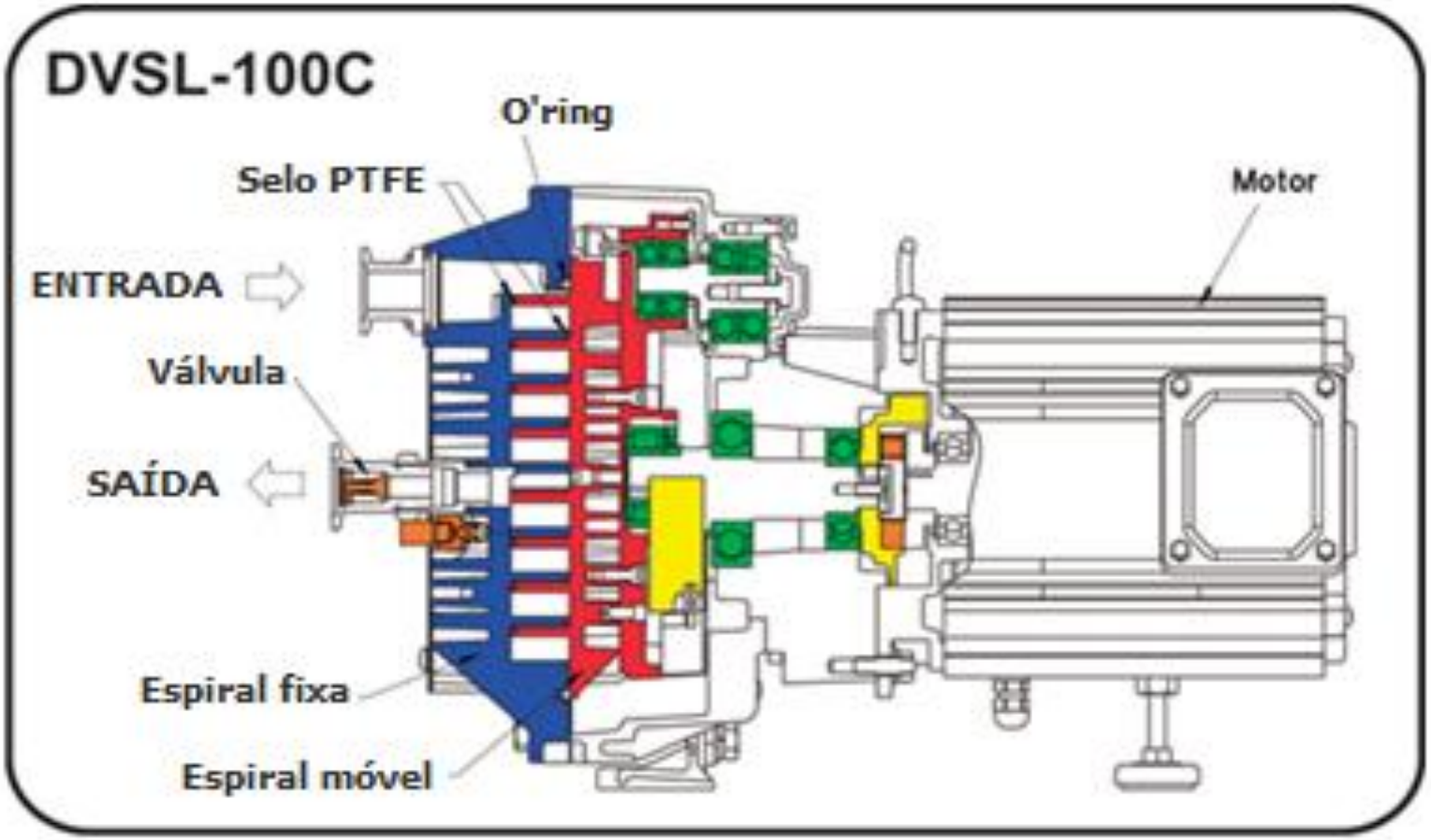
IFUSP

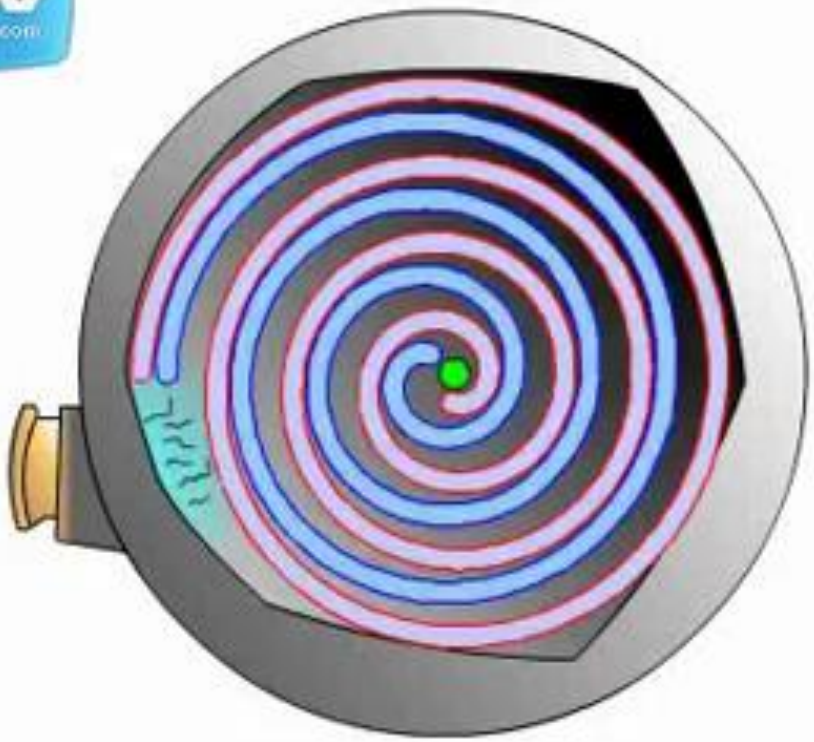

TUBO
FLEXÍVEL
CAME
EXCÊNTRICO

BOMBA SCROLL

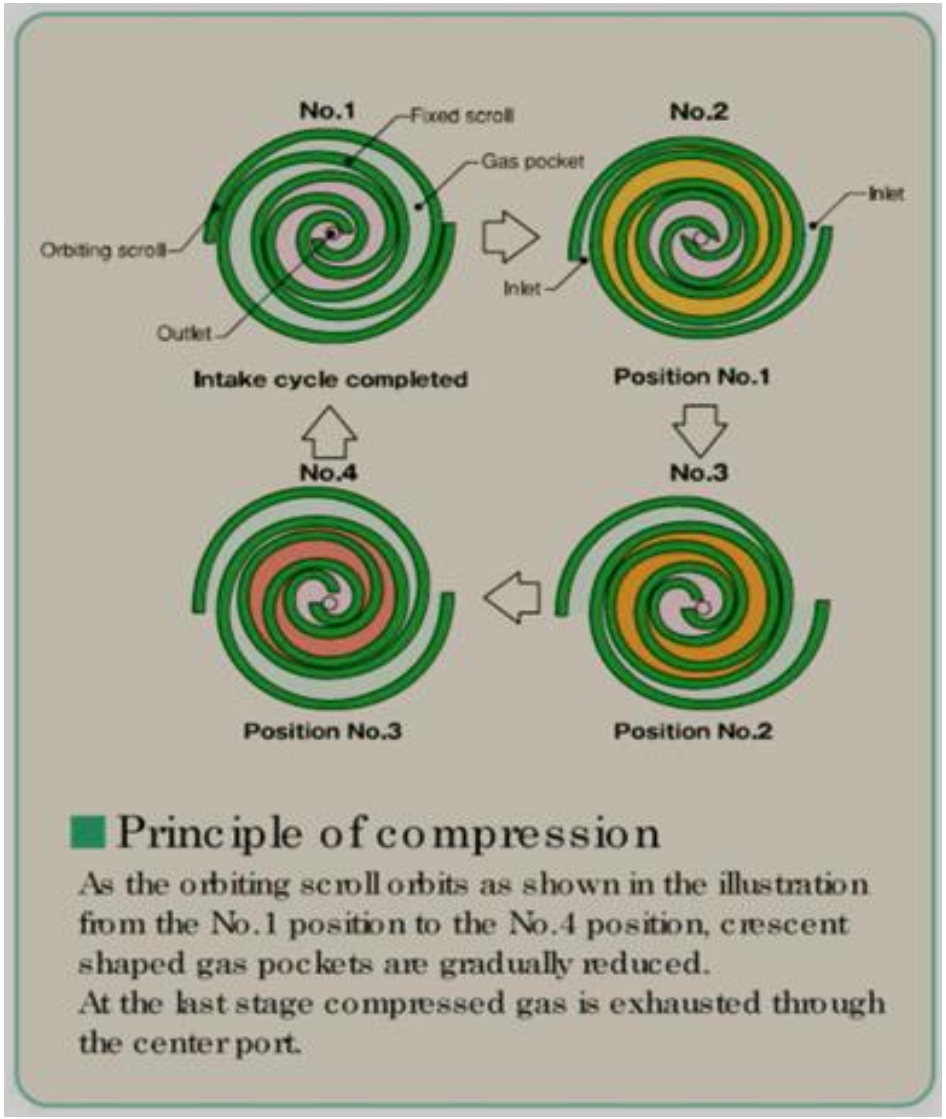


BOMBA DO TIPO ESPIRAL ("SCROLL")

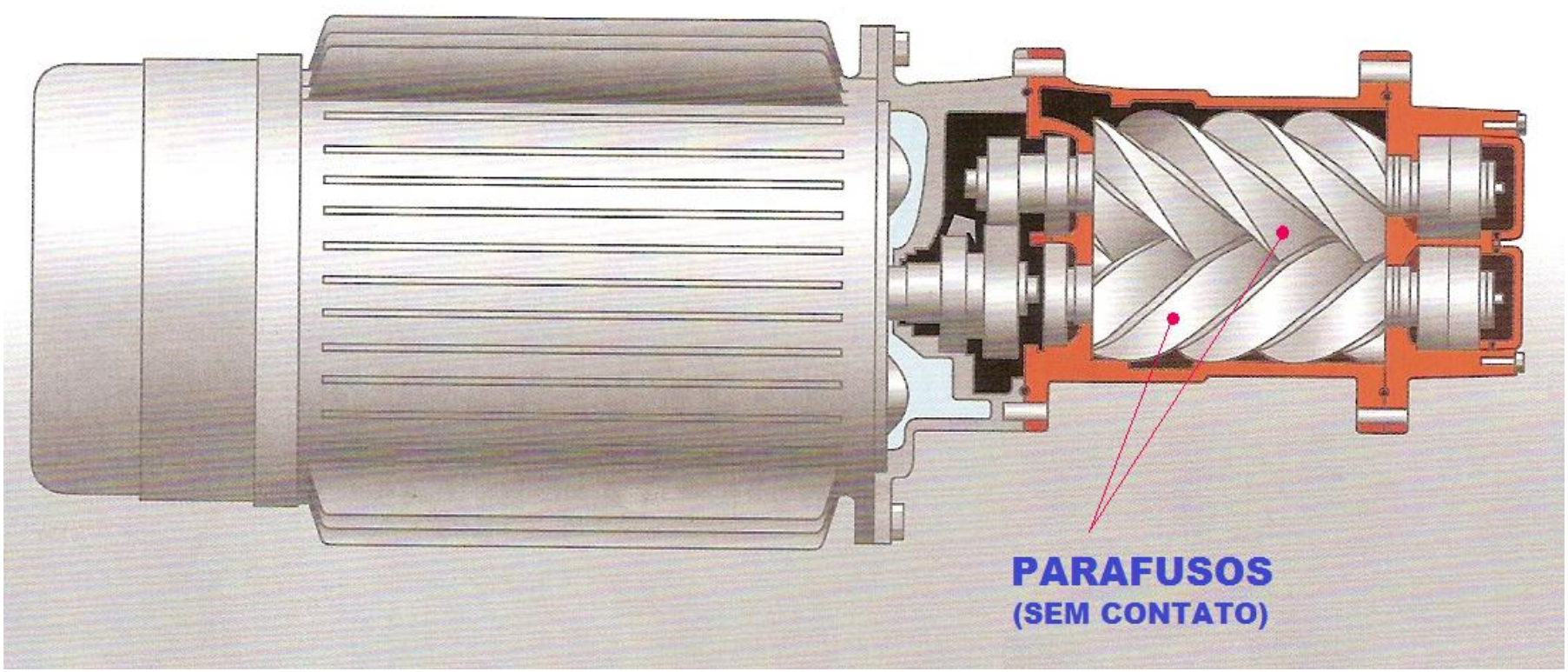




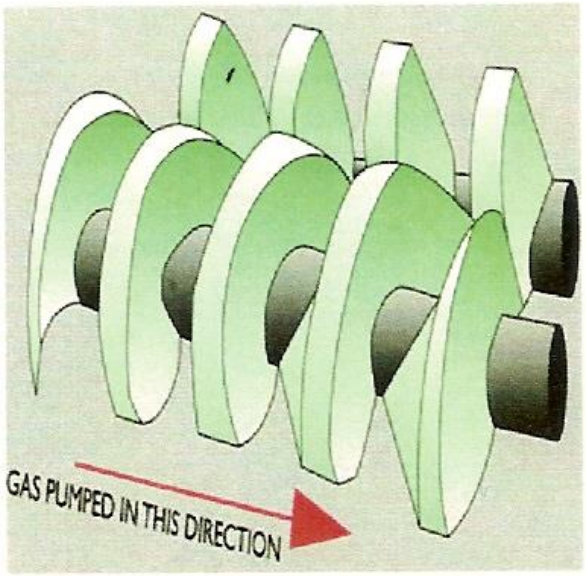
BOMBA DO TIPO ESPIRAL ("SCROLL")

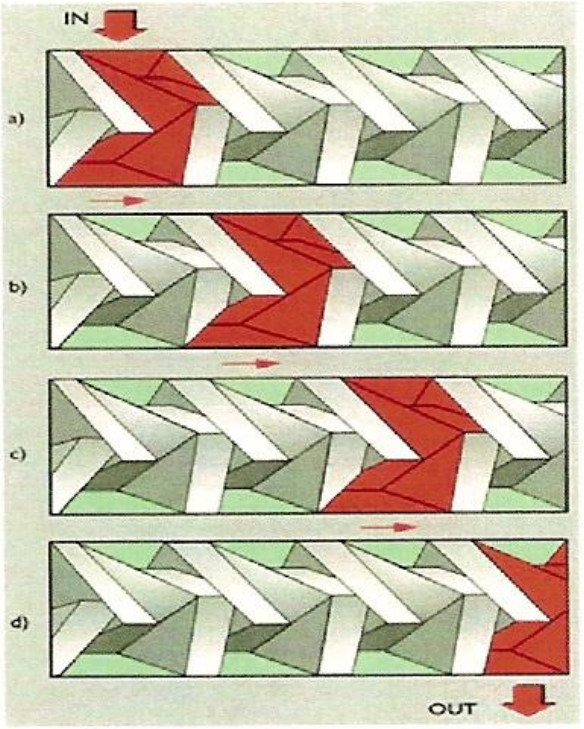


BOMBA DE PARAFUSOS

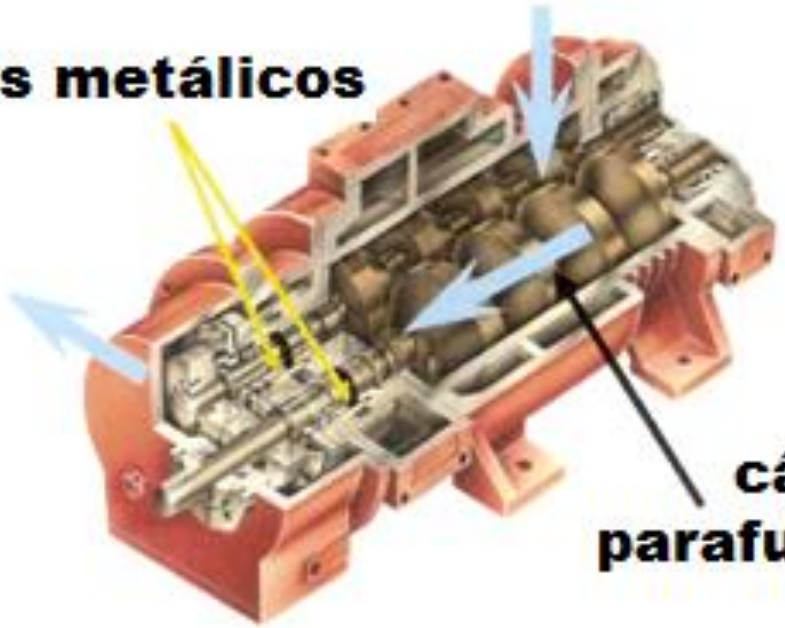


BOMBA AUTOLUBRIFICADA - TIPO DE PARAFUSOS





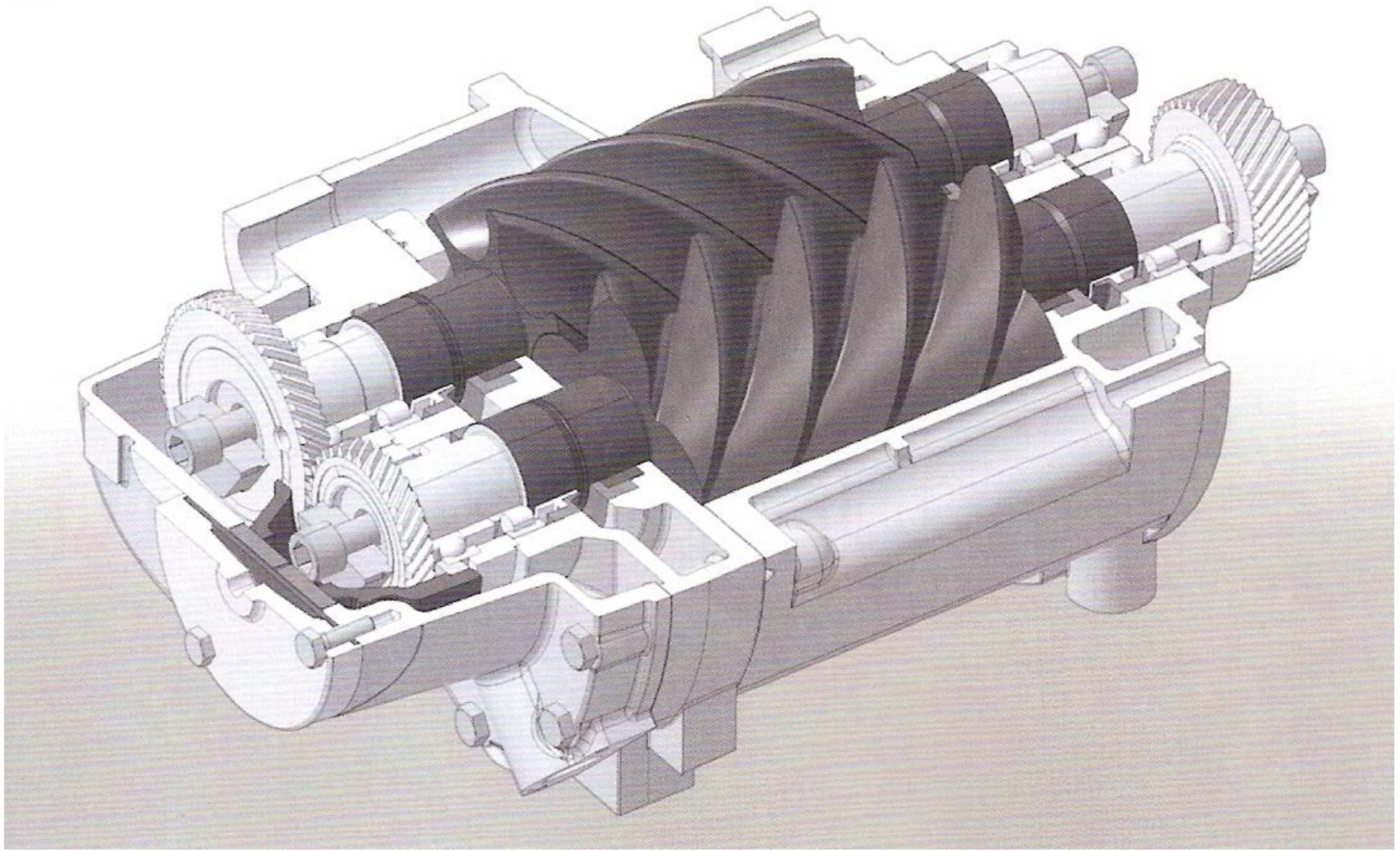
BOMBA AUTOLUBRIFICADA - TIPO DE PARAFUSOS



Pressão final: 5×10^{-2} **Torr**

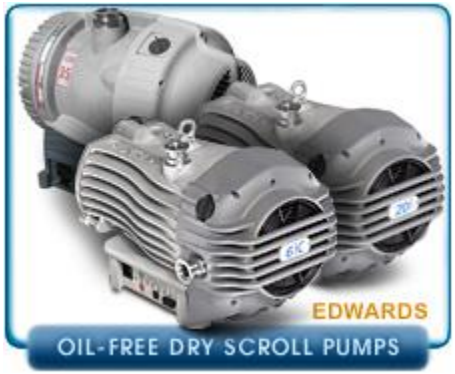
Velocidade: **90 a 460 cfm**

BOMBA DE PARAFUSOS

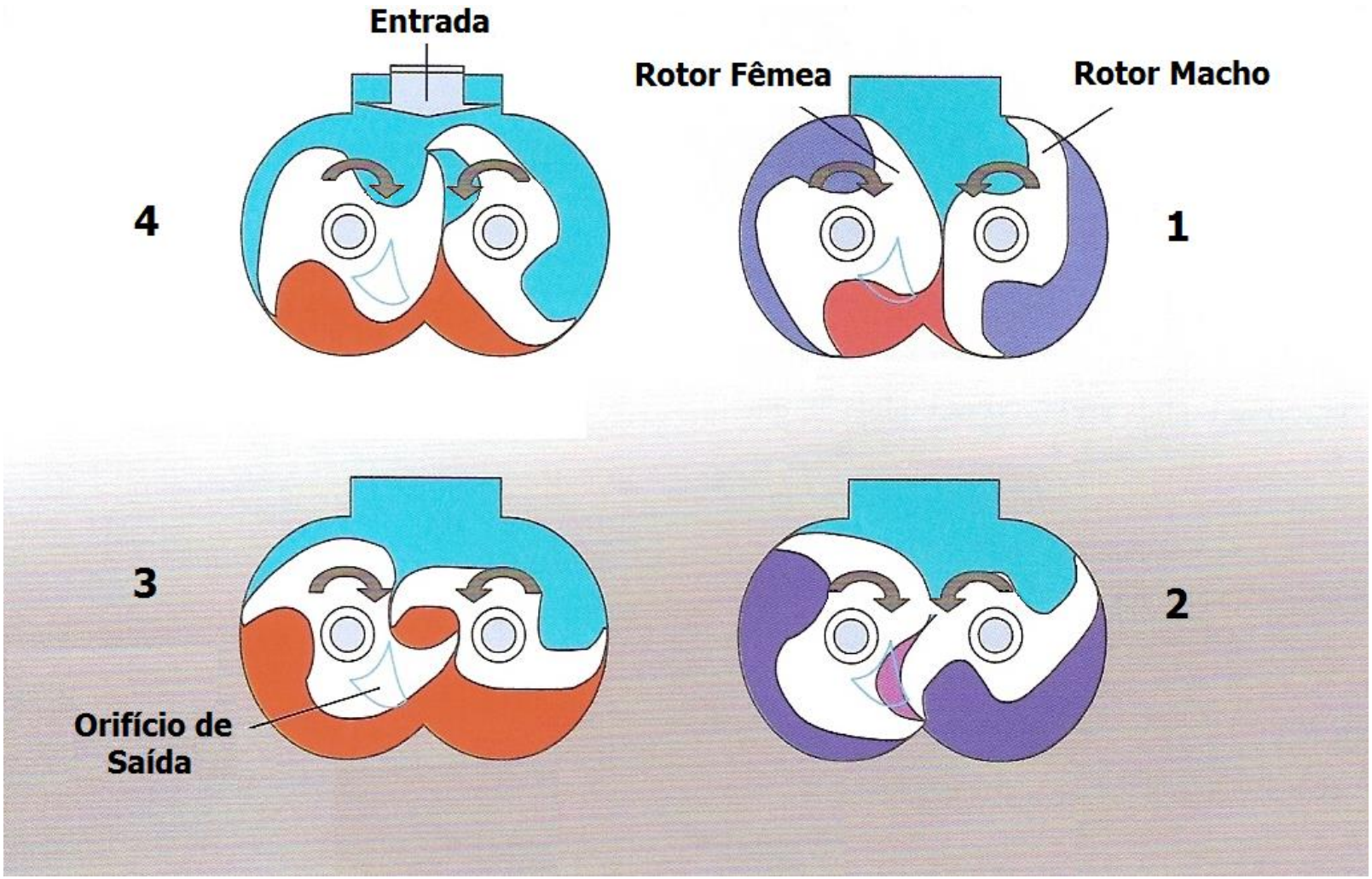


BOMBAS AUTOLUBRIFICADAS ("DRY")

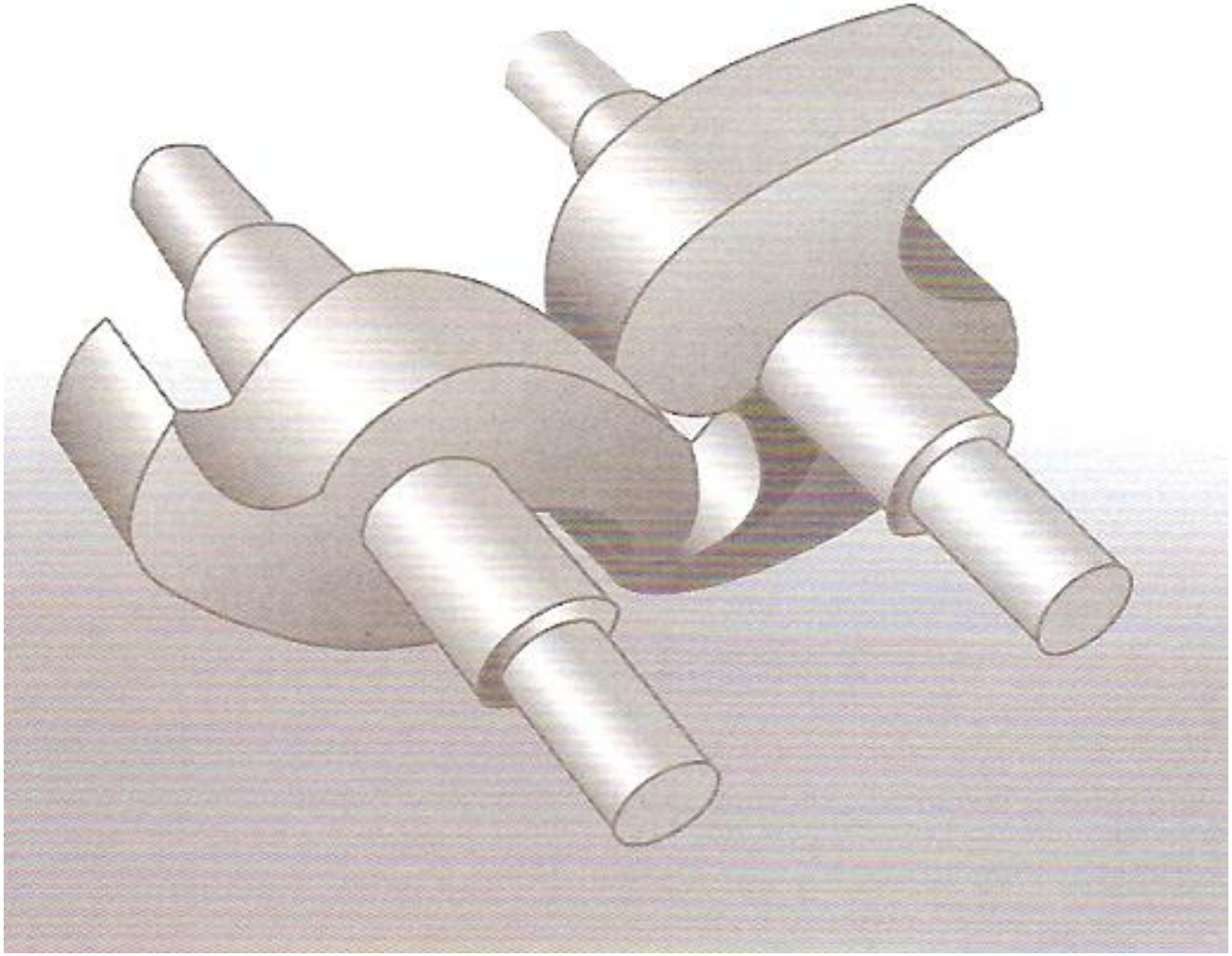
TIPO ESPIRAL ("SCROLL")



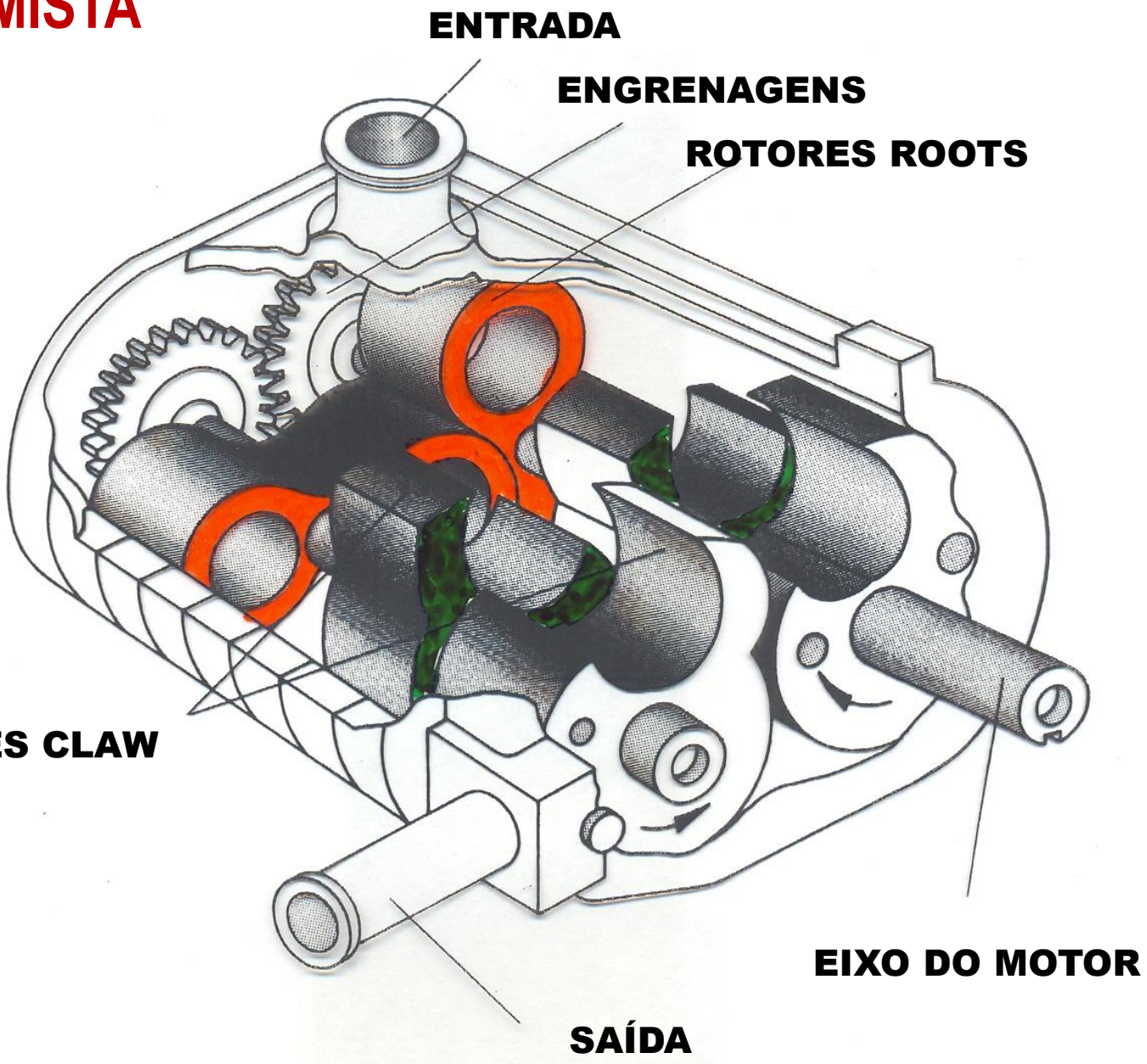
ROTORES "CLAW"



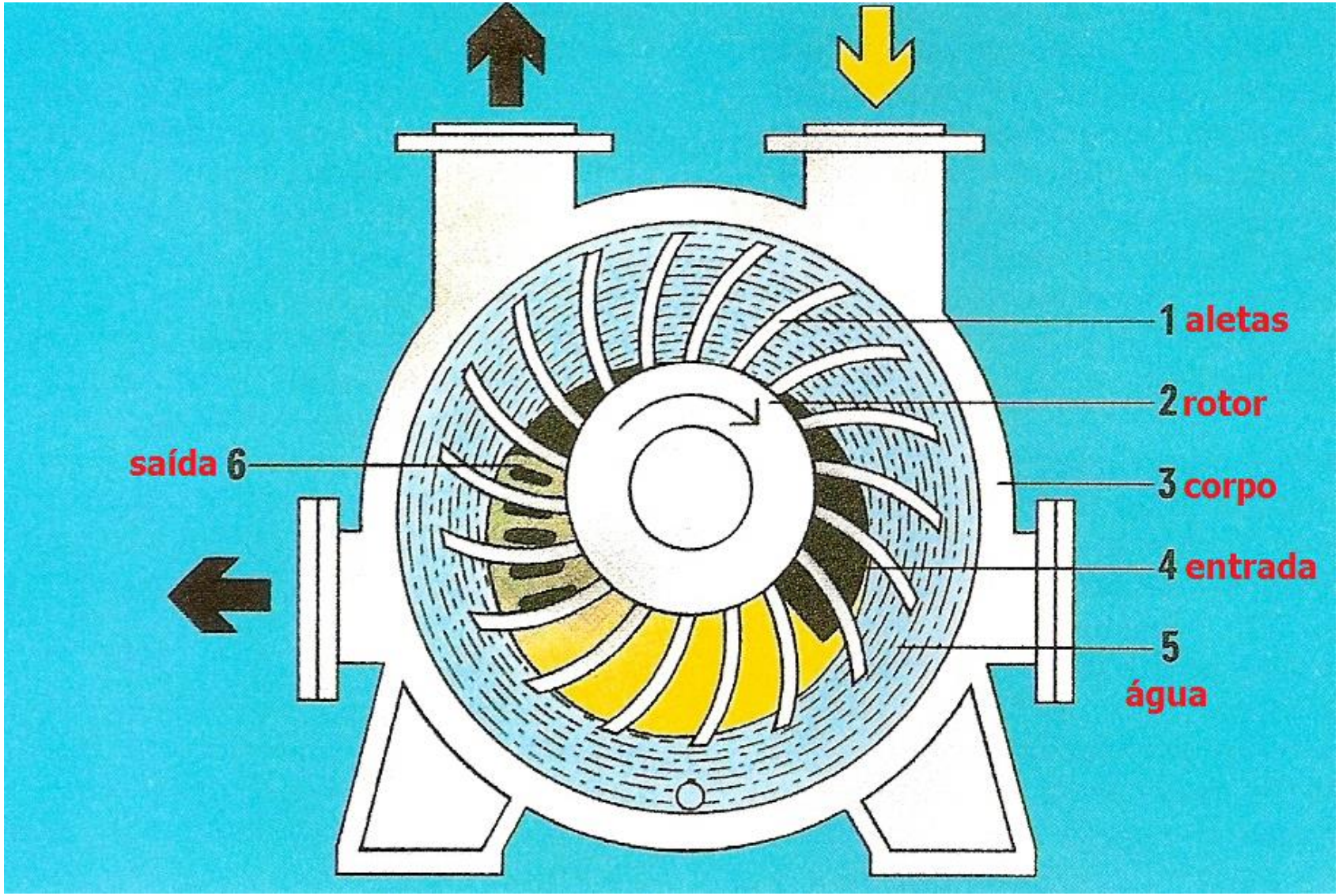
ROTORES "CLAW"



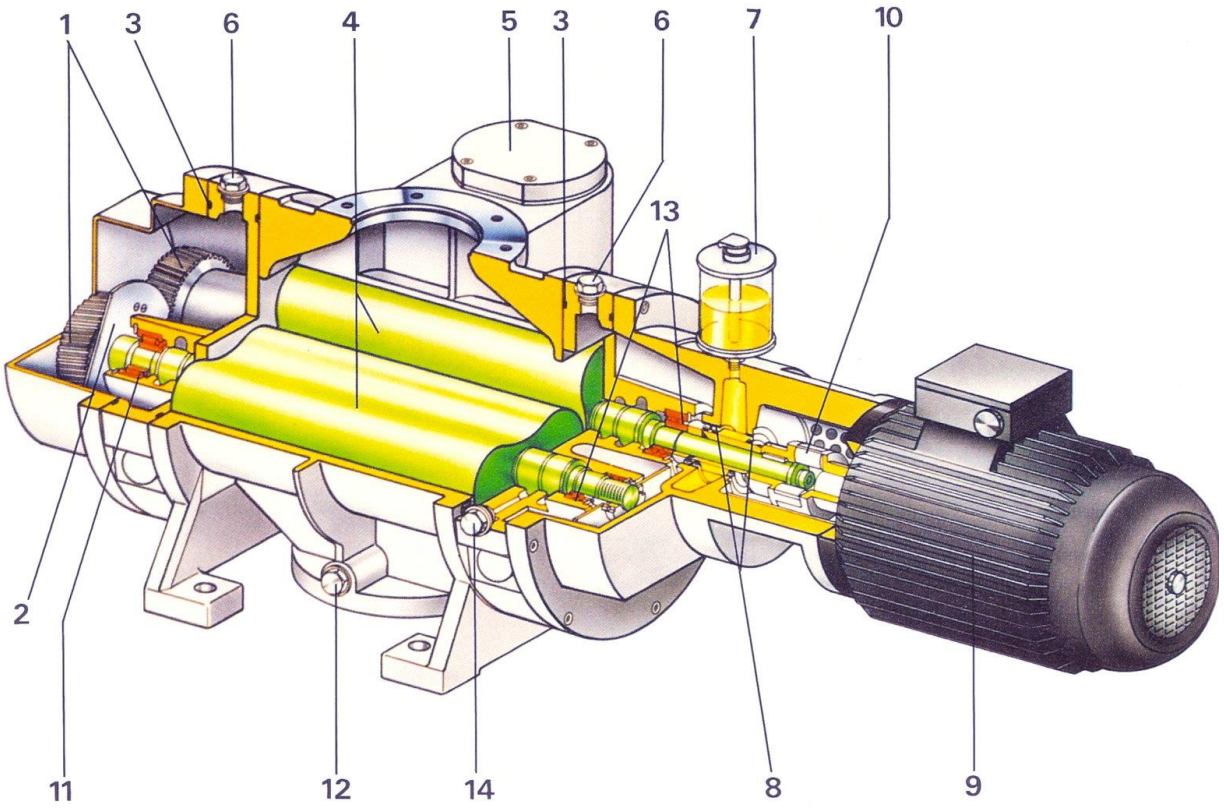
BOMBA MISTA


ENTRADA
ENGRENAGENS
ROTORES ROOTS
ROTORES CLAW
EIXO DO MOTOR
SAÍDA

BOMBA DE ANEL LÍQUIDO

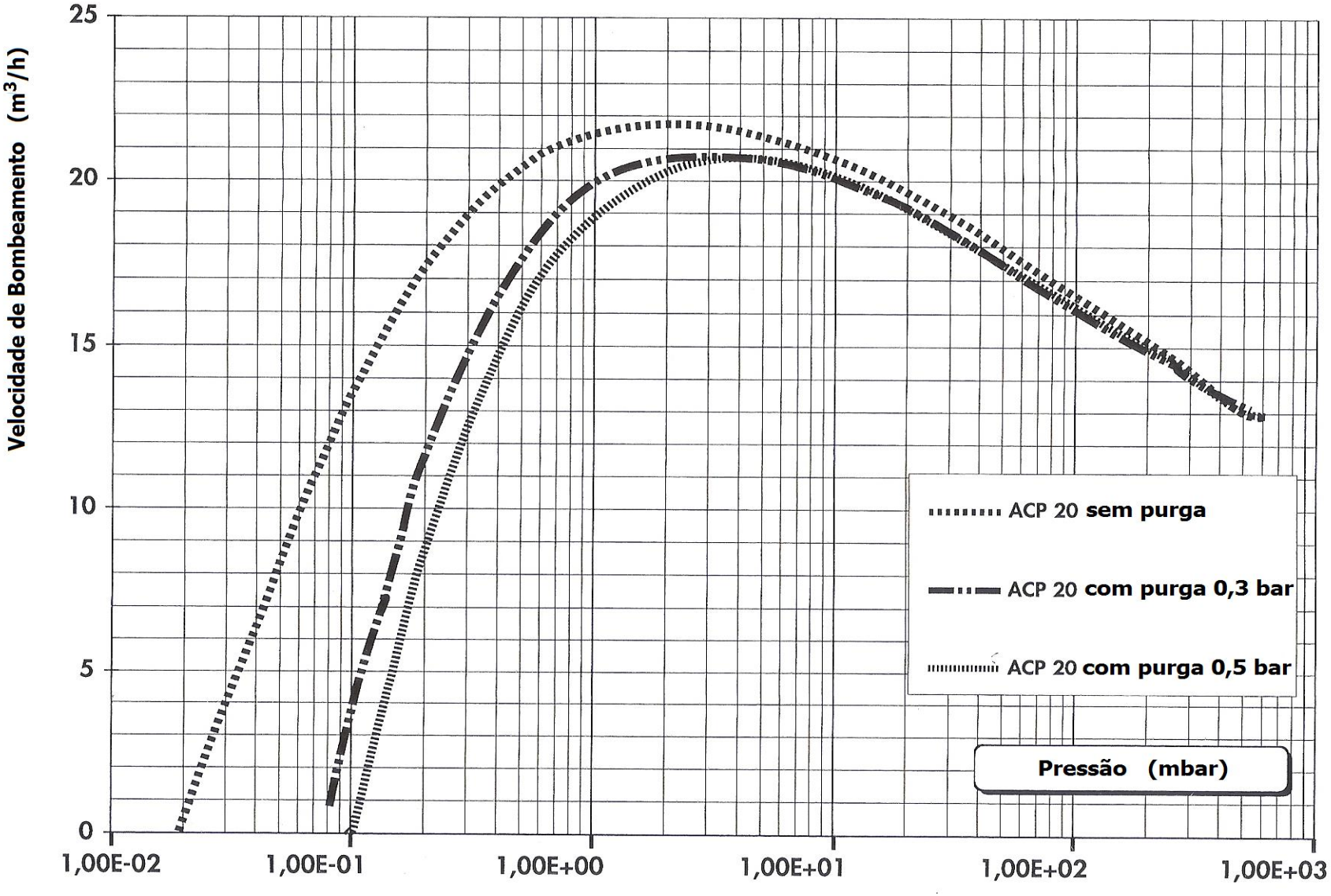


BOMBA ROOTS - CORTE



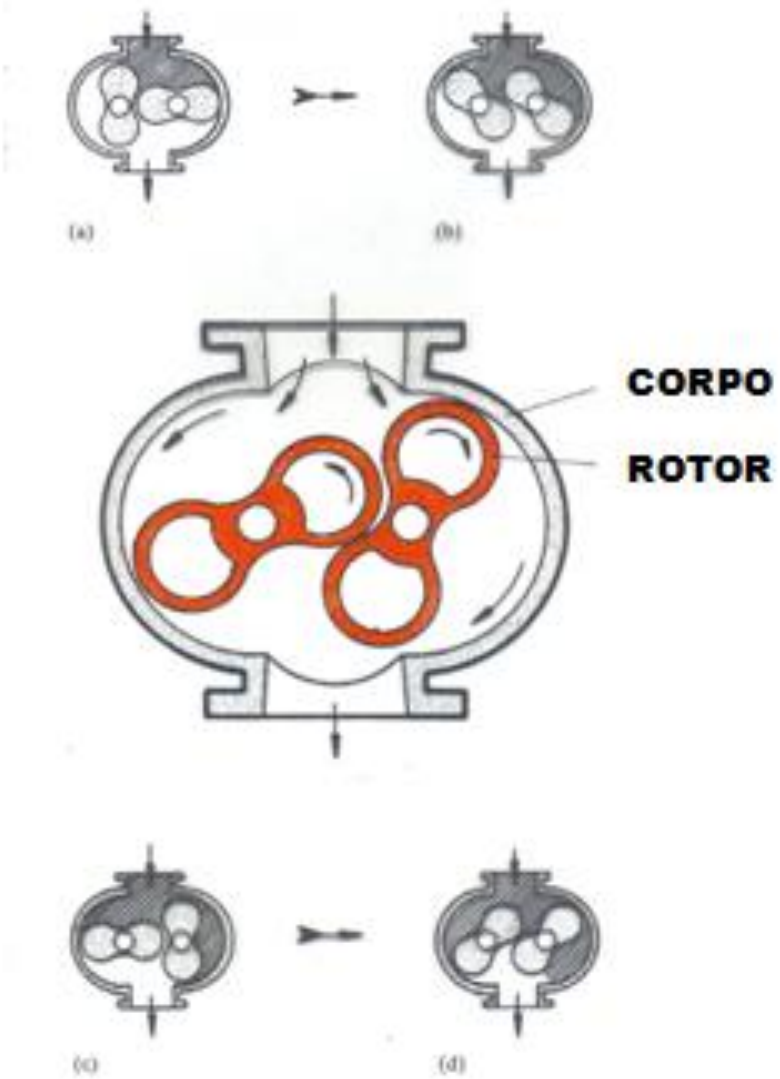
1 Engrenagens
2 Disco de óleo
3 O'ring
4 Rotores
5 Válvula de escape
6 Conexão de vácuo
7 Óleo
8 Gaxetas do eixo
9 Motor
10 Acoplamento
11 Rolamento
12 Medidor
13 Rolamentos
14 Conexão de gás

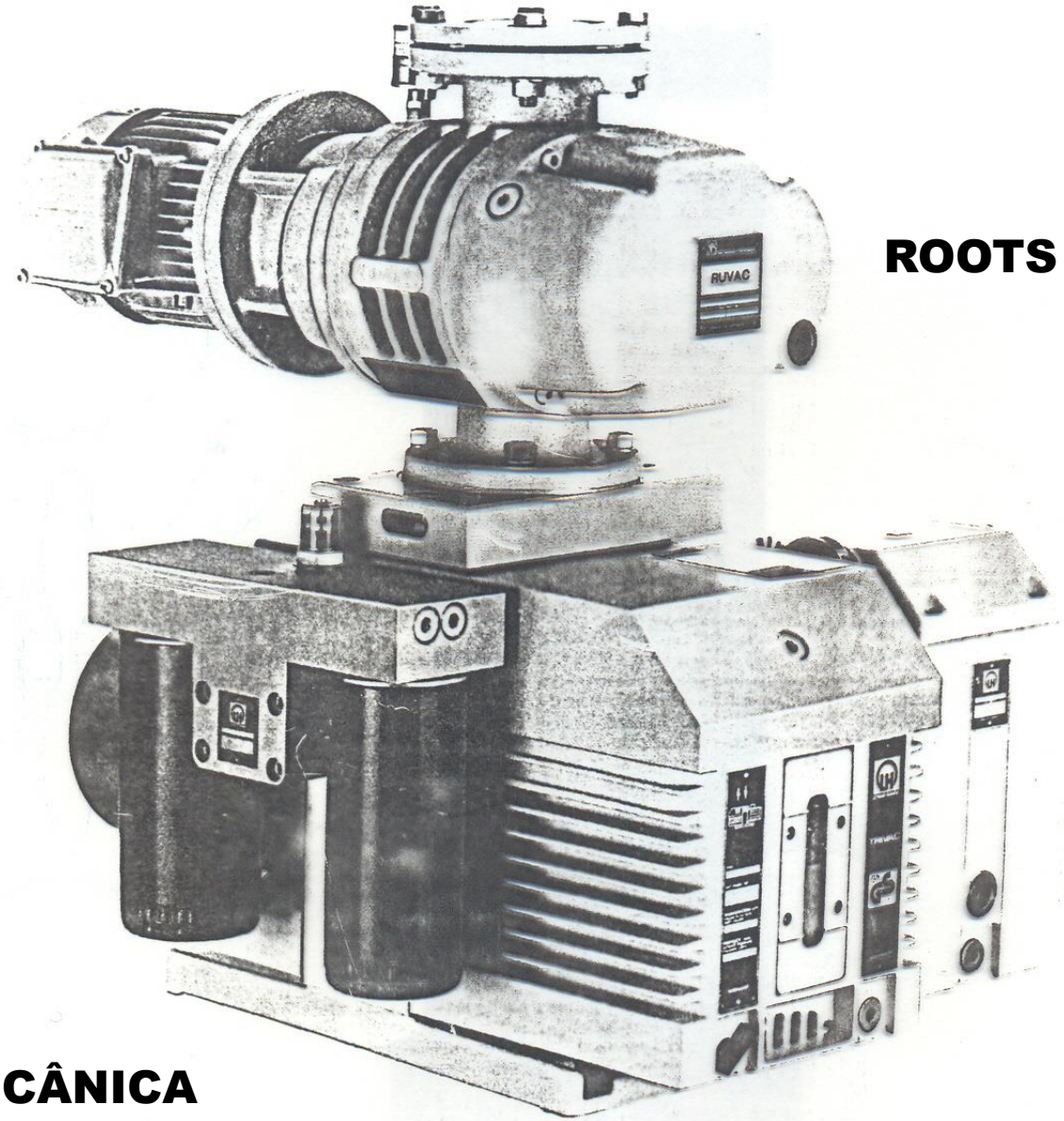
BOMBAS SECAS – CURVAS DE VELOCIDADE



BOMBA ROOTS

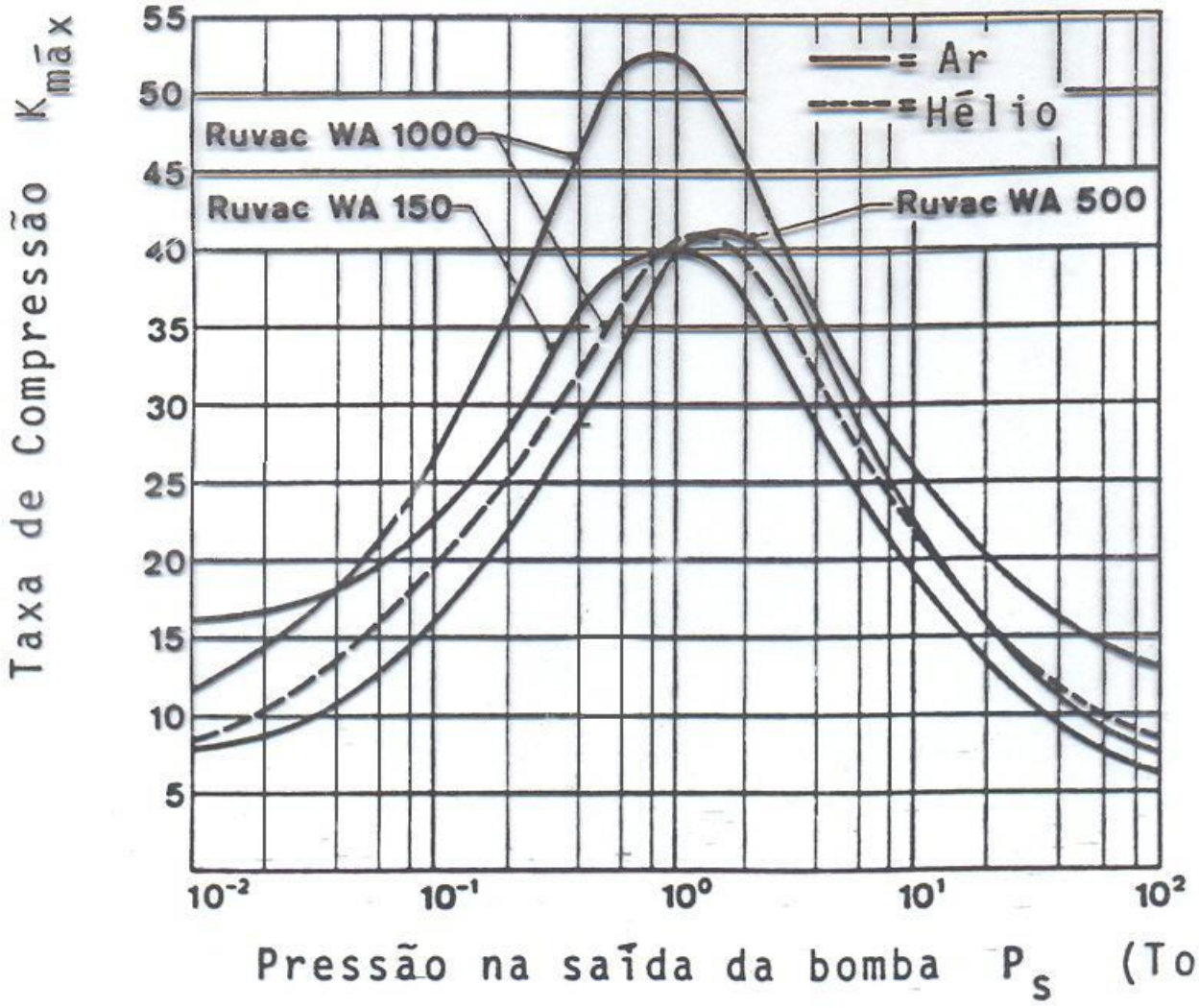
(SEM CONTATO MECÂNICO)





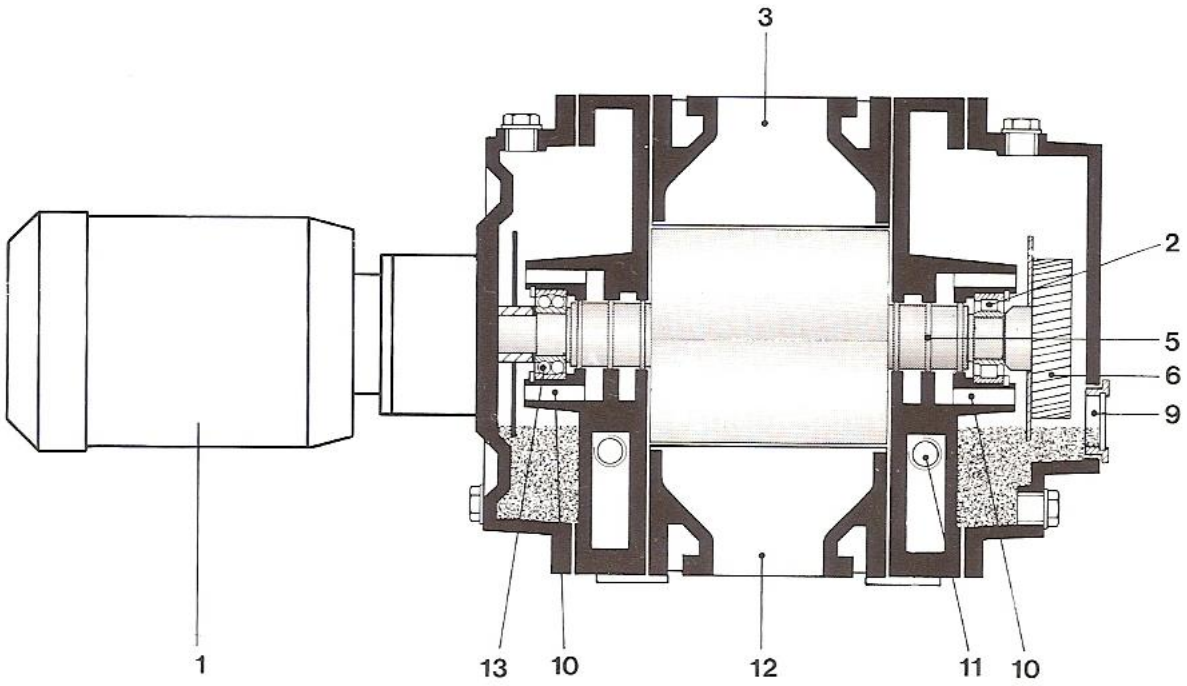
ROOTS

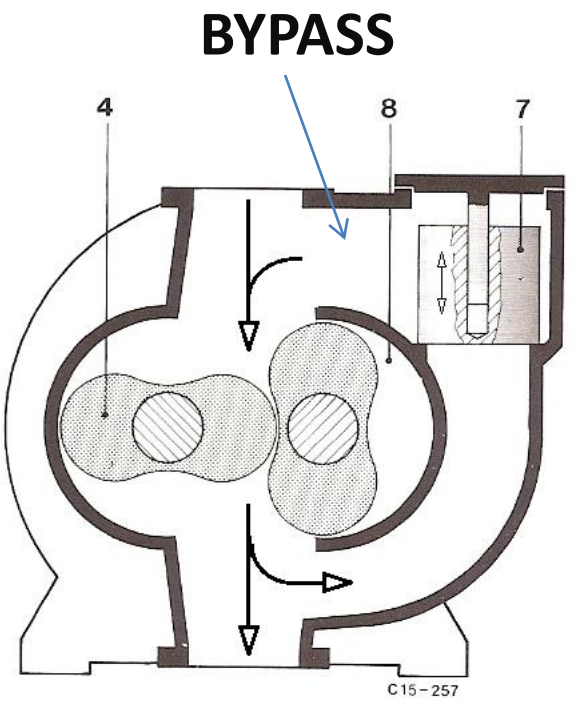
BOMBA MECÂNICA



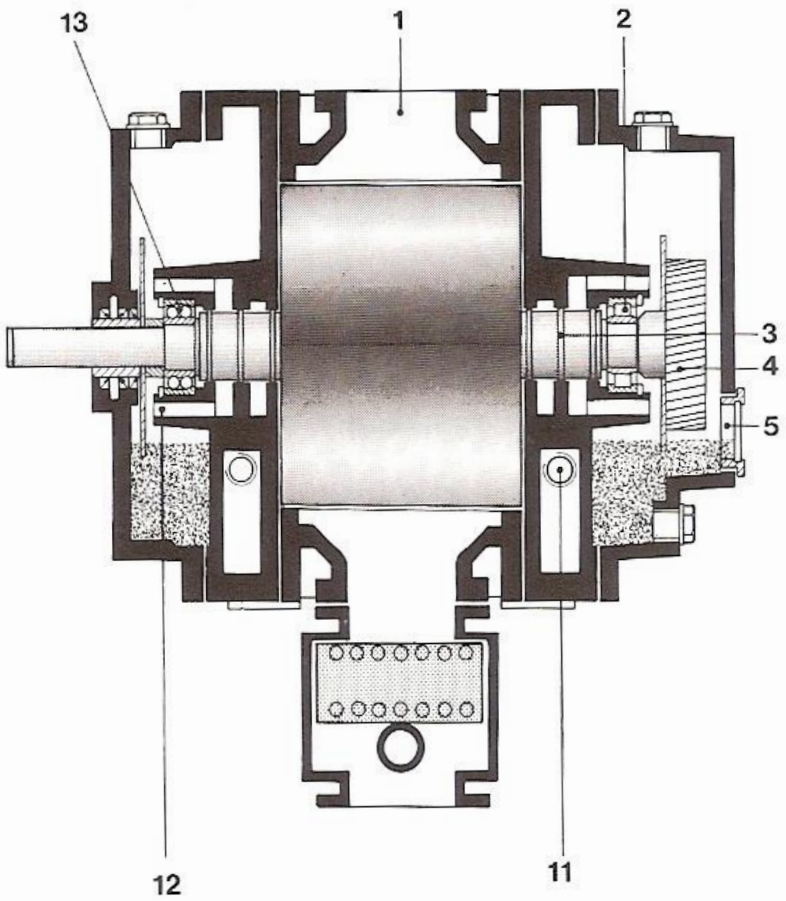
Variação da taxa de compressão $K_{máx}$ com a Pressão P_s na saída da bomba.

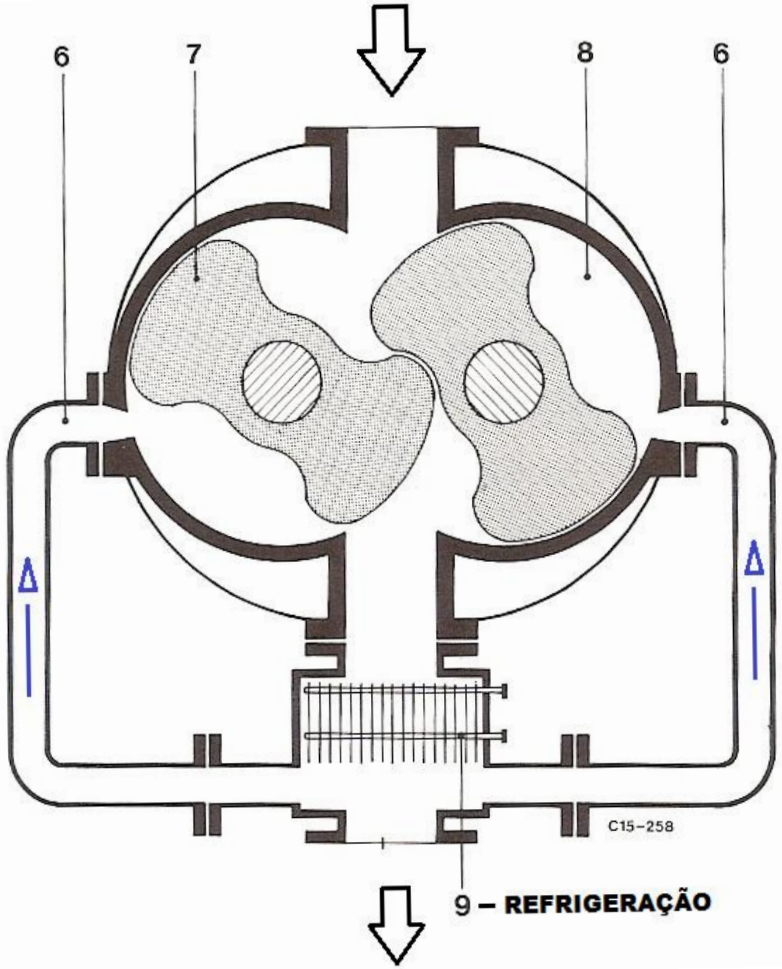
BOMBA ROOTS COM “BYPASS”





BOMBA ROOTS COM PURGA





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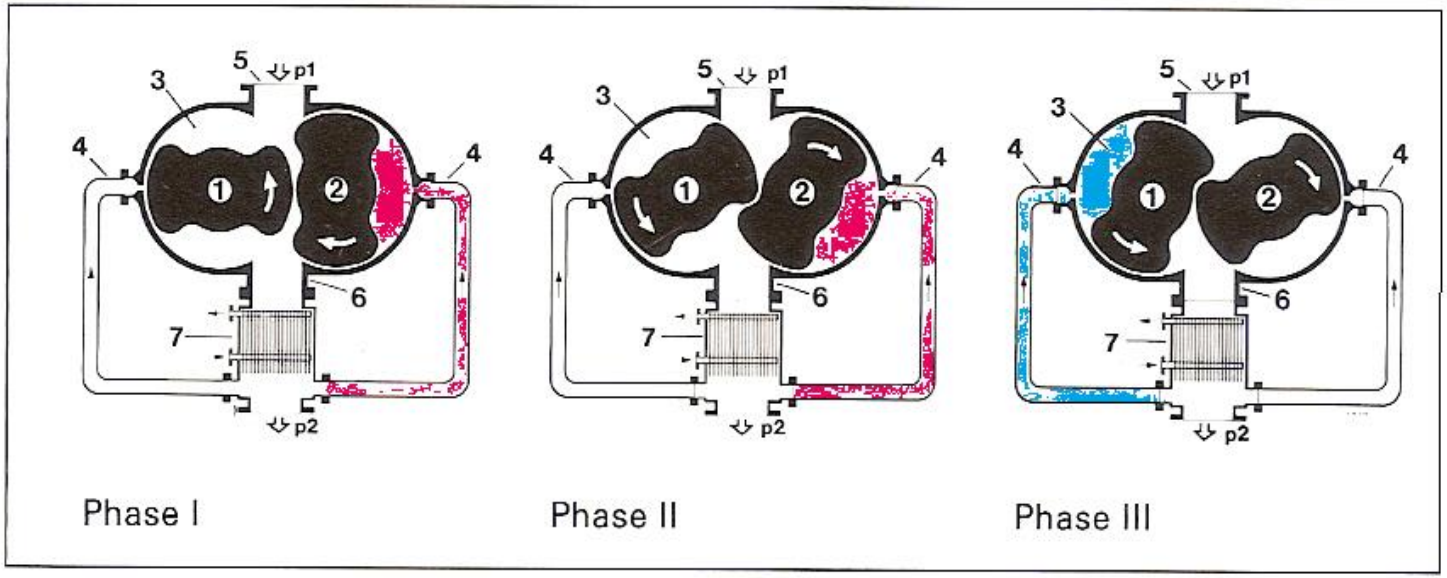
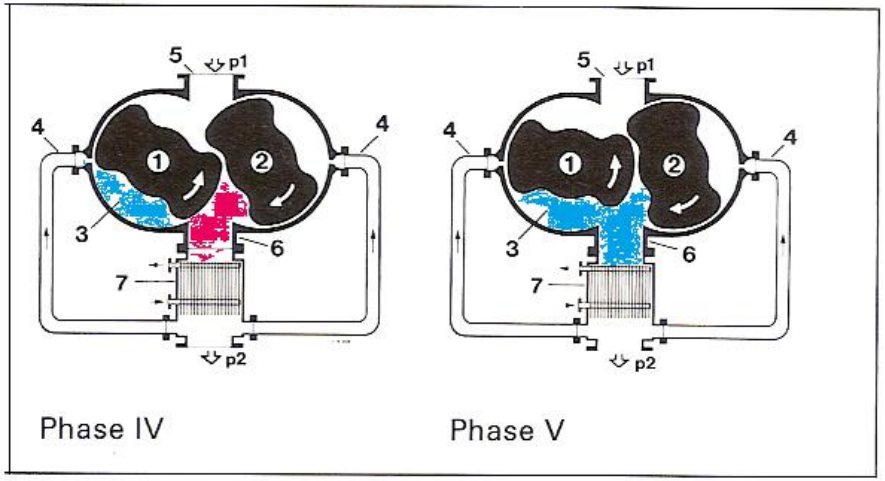
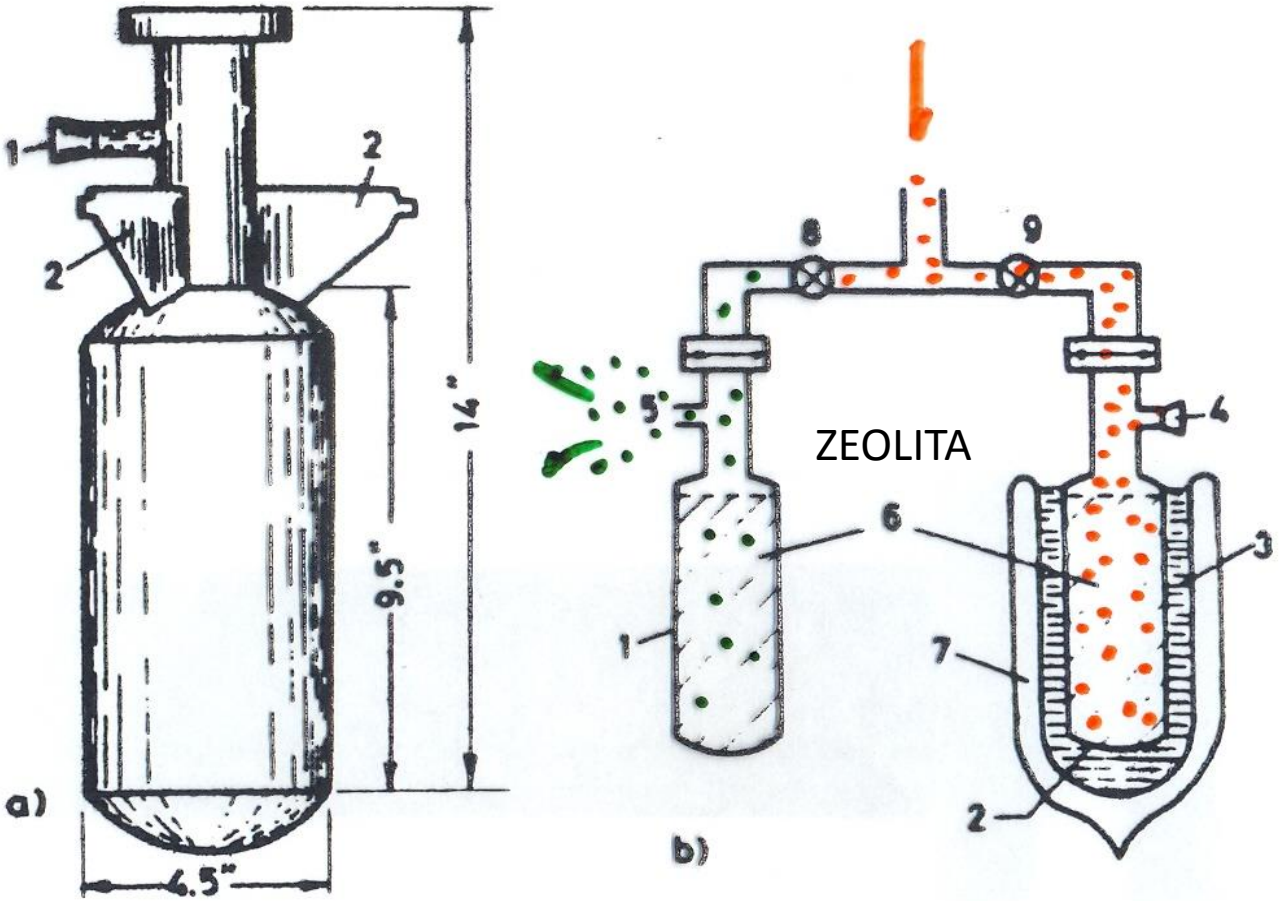
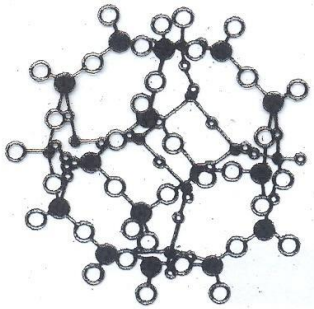




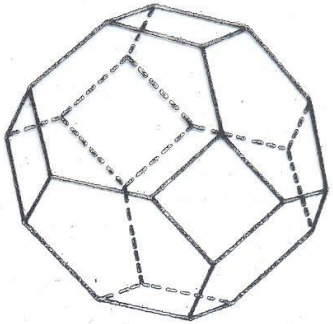
BOMBA DE SORPÇÃO



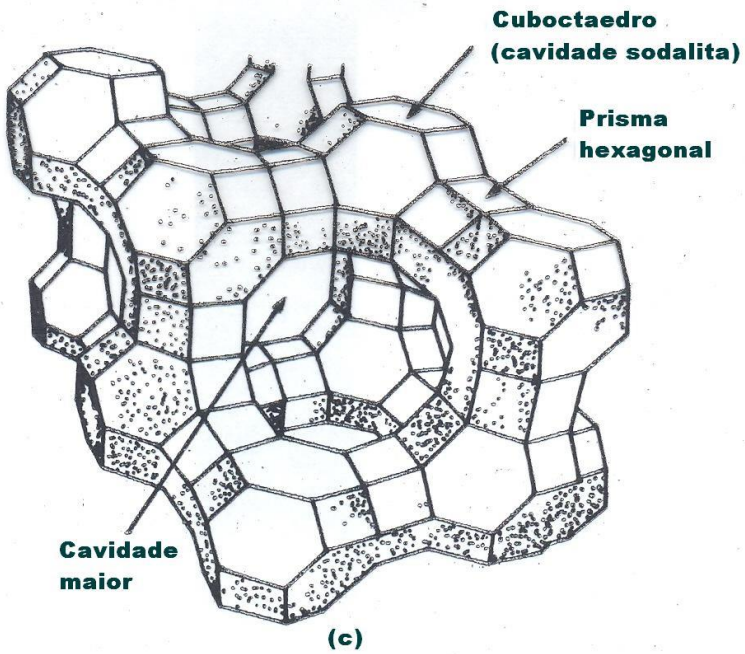
ZEÓLITA



(a)



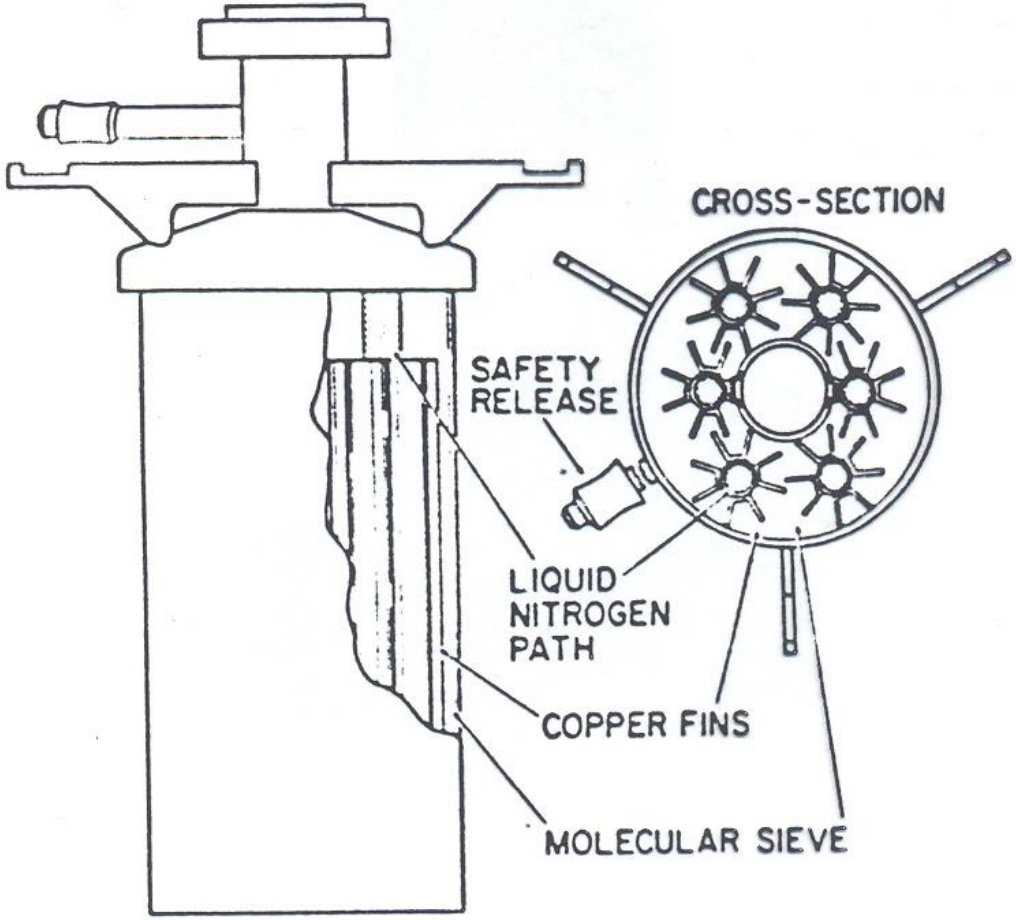
(b)



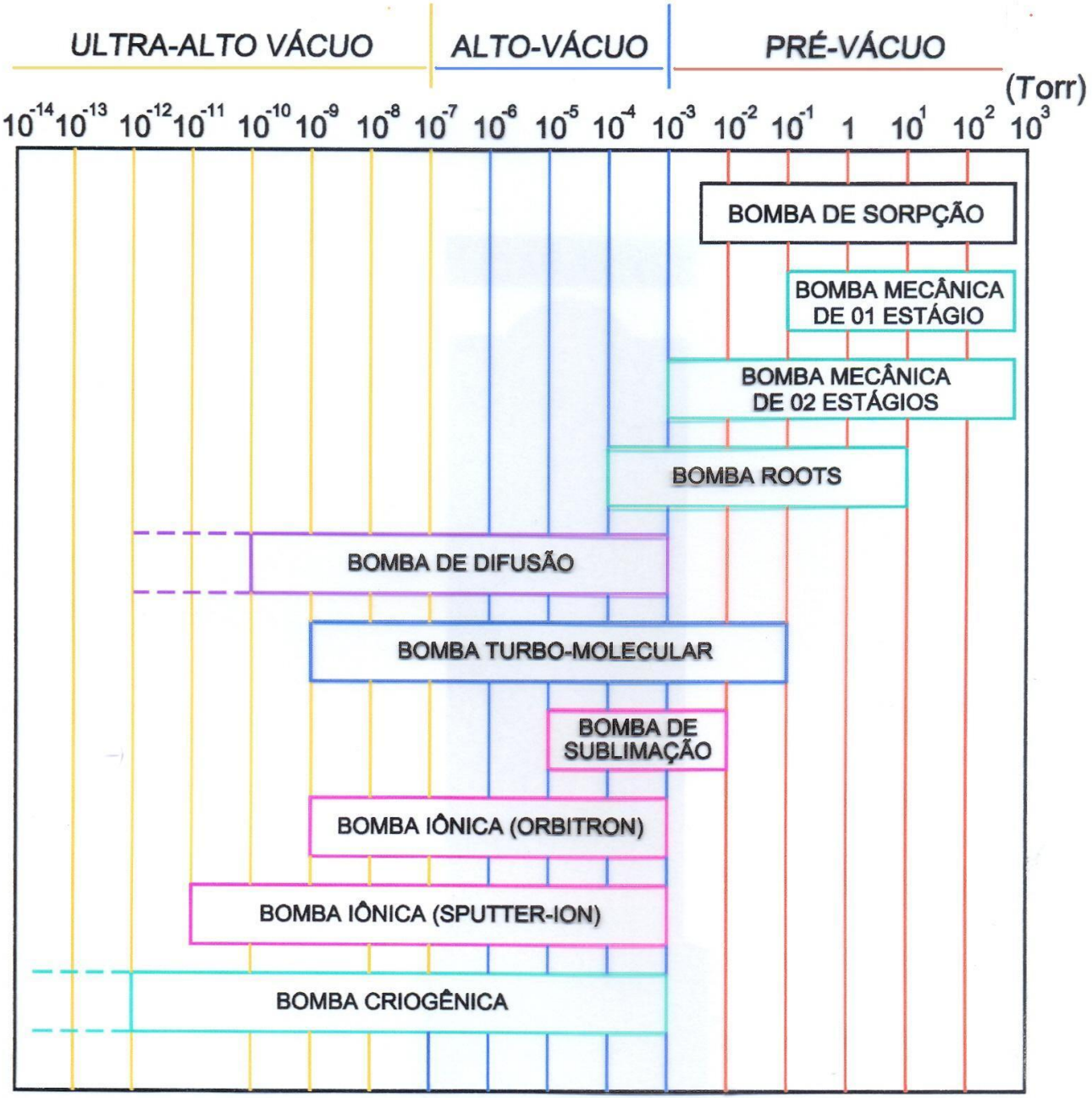
(c)

Estrutura de uma zeólita. (b) Representação simplificada do cuboctaedro (a), onde aparecem os átomos de oxigênio [o] e os de alumínio ou silício [●]. Estes cuboctaedros unidos formam a zeólita (c).

BOMBA DE SORPÇÃO



Typical liquid-nitrogen-cooled sorption pump. Reprinted with permission from Ultek Division, Perkin-Elmer Corp., Palo Alto, CA 94303.


ULTRA-ALTO VÁCUO
ALTO-VÁCUO
PRÉ-VÁCUO
(Torr)
10^{-14} 10^{-13} 10^{-12} 10^{-11} 10^{-10} 10^{-9} 10^{-8} 10^{-7} 10^{-6} 10^{-5} 10^{-4} 10^{-3} 10^{-2} 10^{-1} 1 10^{1} 10^{2} 10^{3}
BOMBA DE SORPÇÃO
BOMBA MECÂNICA DE 01 ESTÁGIO
BOMBA MECÂNICA DE 02 ESTÁGIOS
BOMBA ROOTS
BOMBA DE DIFUSÃO
BOMBA TURBO-MOLECULAR
BOMBA DE SUBLIMAÇÃO
BOMBA IÔNICA (ORBITRON)
BOMBA IÔNICA (SPUTTER-ION)
BOMBA CRIOGÊNICA

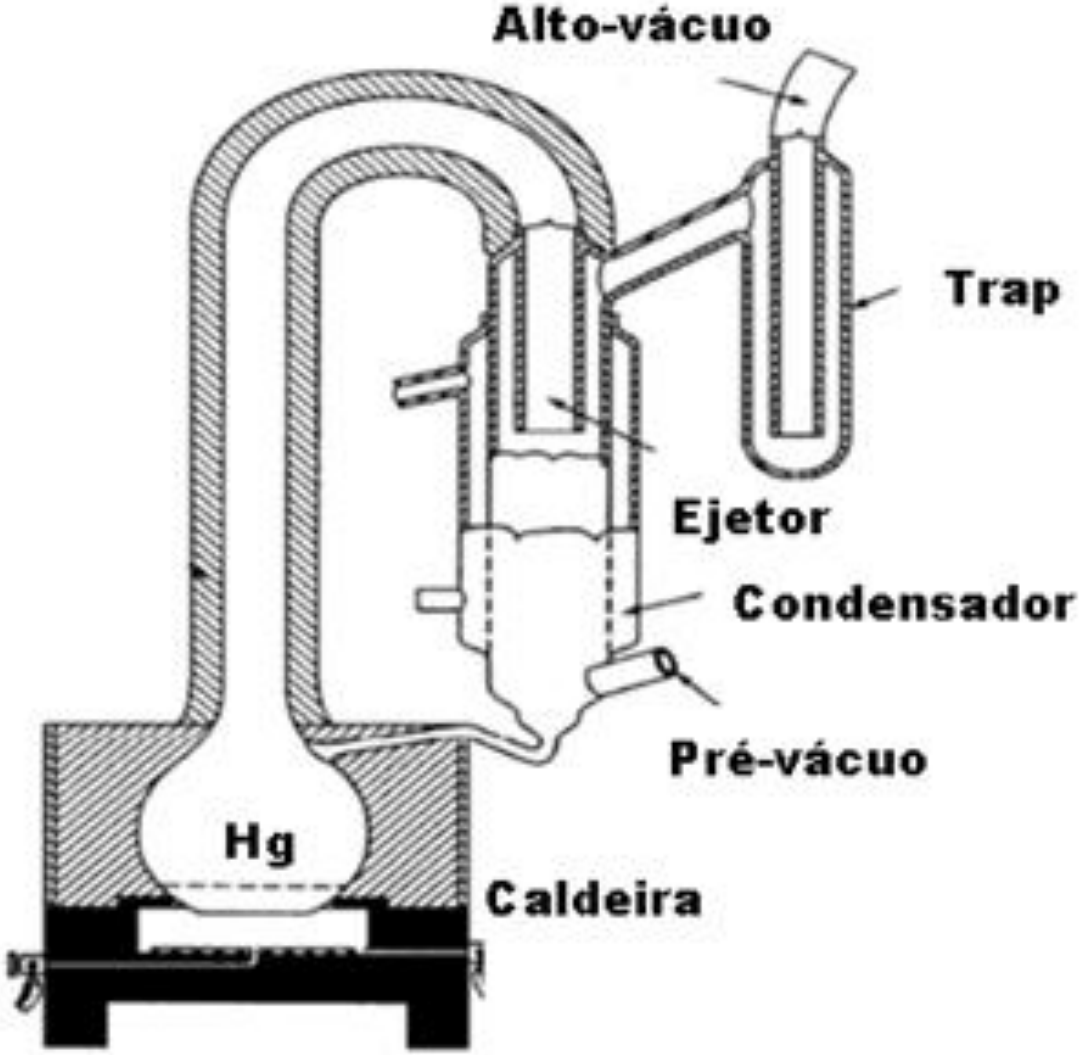
BOMBA DE DIFUSÃO A MERCÚRIO

Primeiro modelo

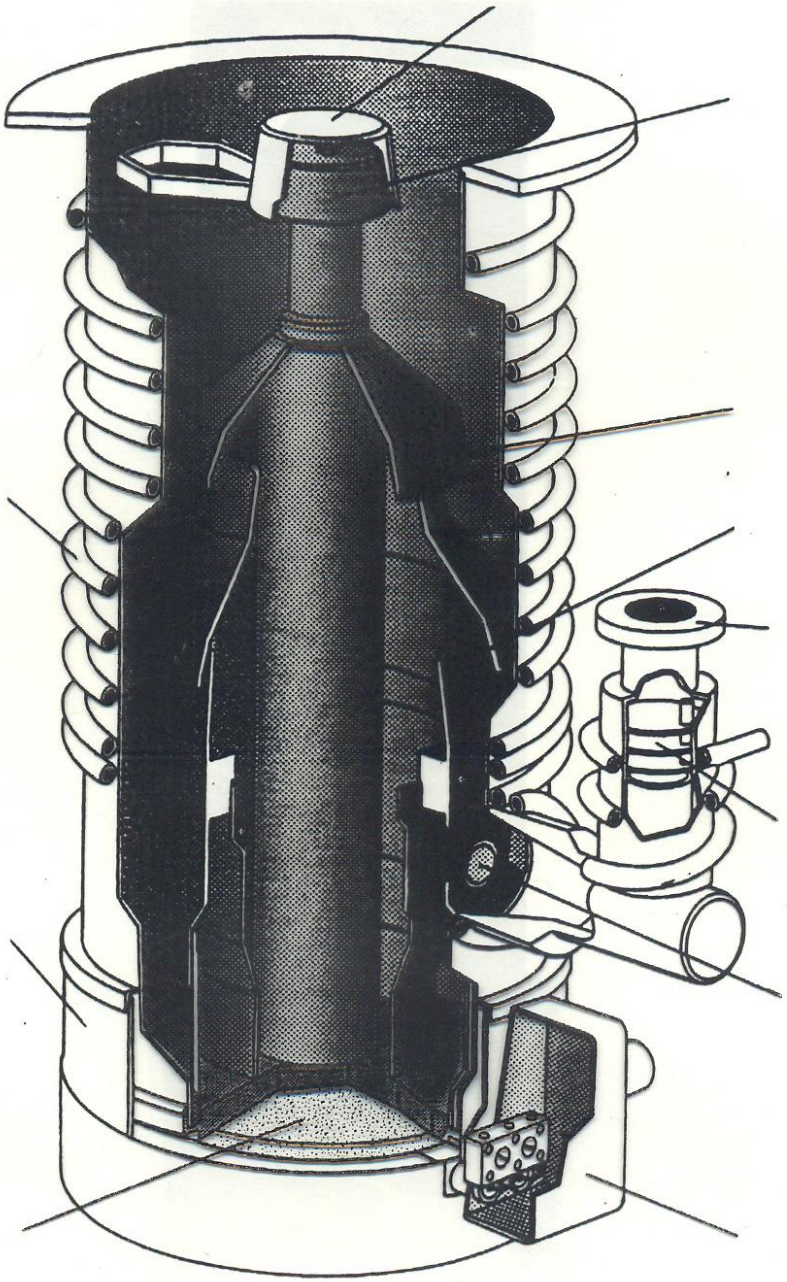
de Langmuir

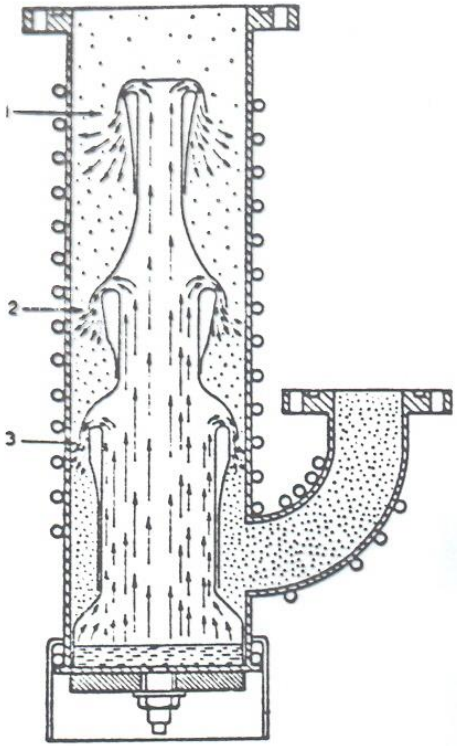
1916

(2 x 10^{-8} Torr)

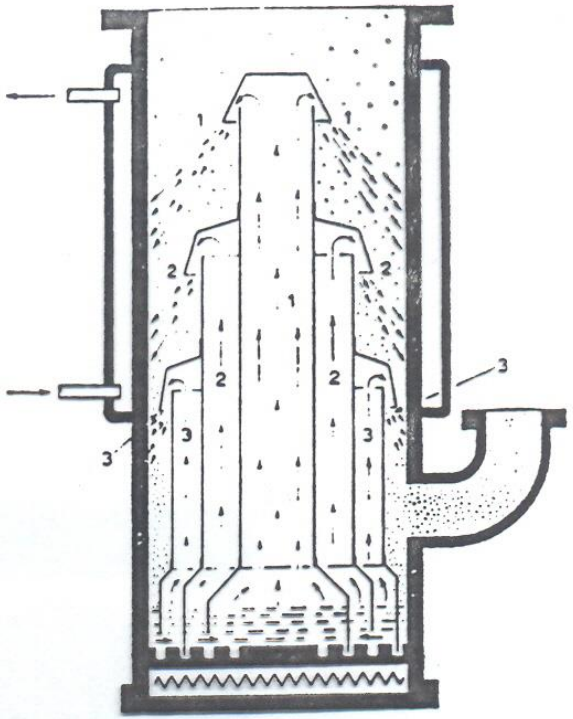


BOMBA DE DIFUSÃO





(a)



(b)

Esquemas de Bombas de Difusão de três estágios

a) desenho mais antigo; o óleo aquecido não sofre nenhum precesso de purificação

b) com tubos concêntricos permitindo a purificação do óleo por - destilação fracionada, durante o funcionamento (o vapor de óleo mais aquecido e limpo sai pelo chapéu ("nozzle") 1.