TOMSK POLYTECHNIC UNIVERSITY

FITTING AND PIPLELINES OF NPP

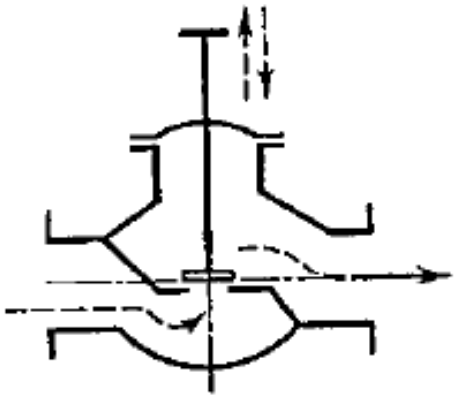
MAIN FEATURES

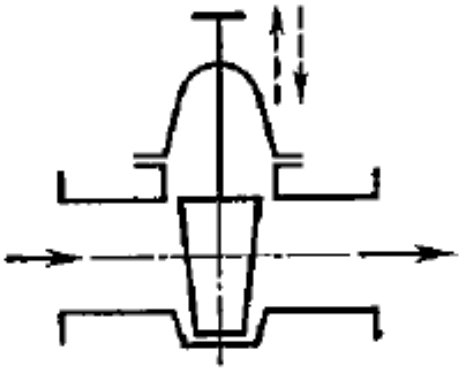
- Fittings:
  - Classification of fittings
  - Construction of shut-off, safety, protective and control fittings
- Pipelines
  - Classification of pipelines on NPP
  - Design and break-down pressures
  - Materials of pipelines
  - Parameters of main pipelines

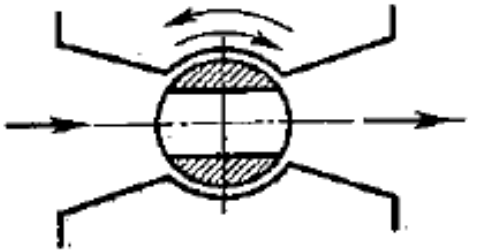
FITTING CLASSIFICATION

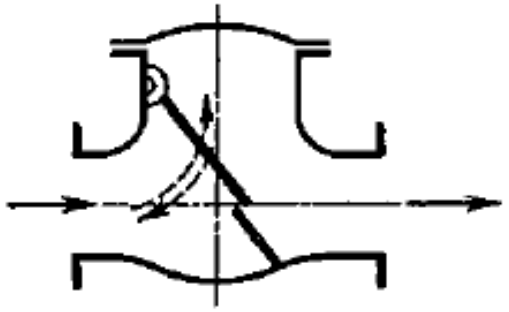
- The fitting – devices needed for ensuring effective and reliable exploitation of NPP. It is installed on the pipelines and designed to control flow of substance by changing resistance and cross-section area of pipeline.
- The main classification is made by purpose:
  - Shut-off – type of fitting which is designed to completely stop flow.
  - Safety – type of fitting which is designed to automatically save equipment from extra high pressure.
  - Protective – type of fitting which is designed to save equipment during emergency situations.
  - Control – type of equipment which is designed to adjust flow rate.

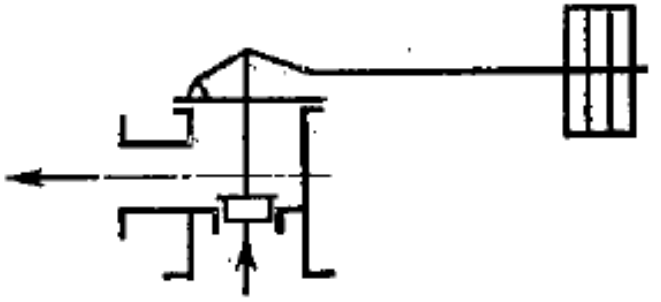
PRINCIPAL CONSTRUCTION OF FITTINGS







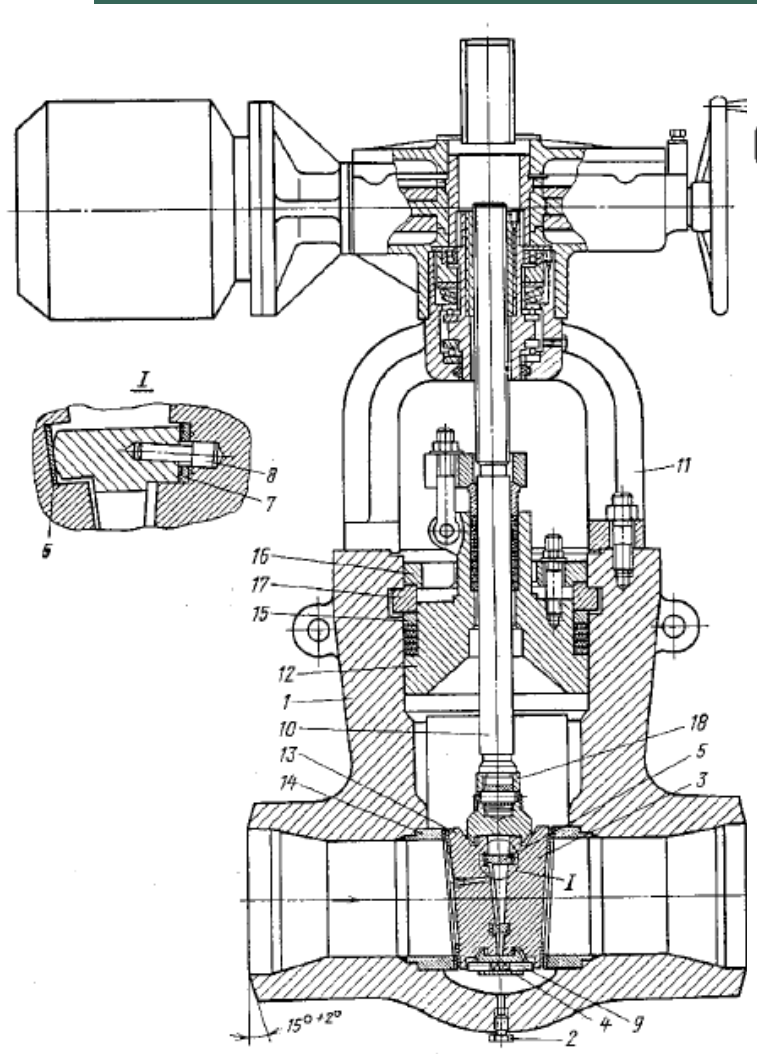


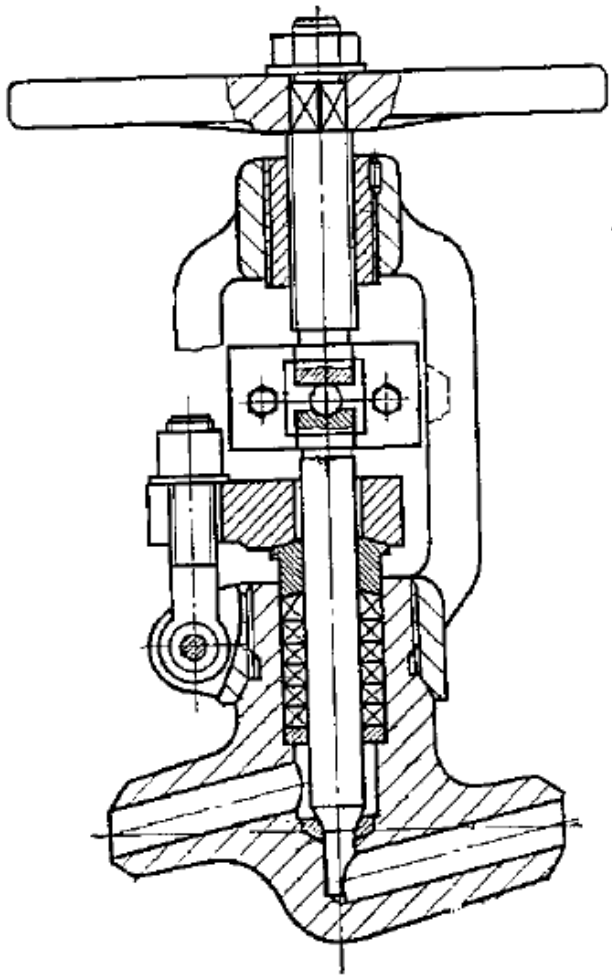


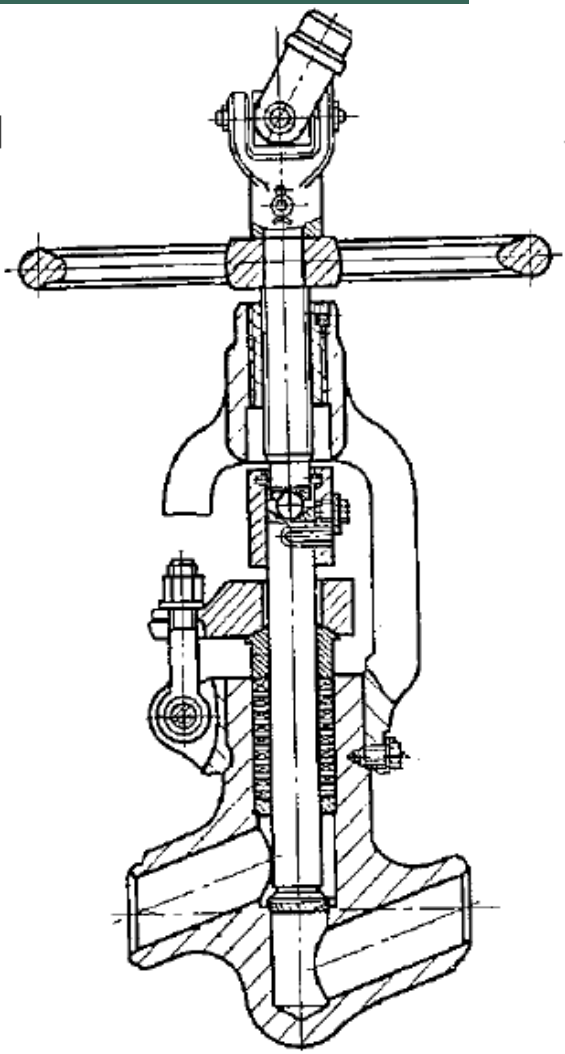
METHOD OF FITTING SEALING FROM OUTSIDE SPACE

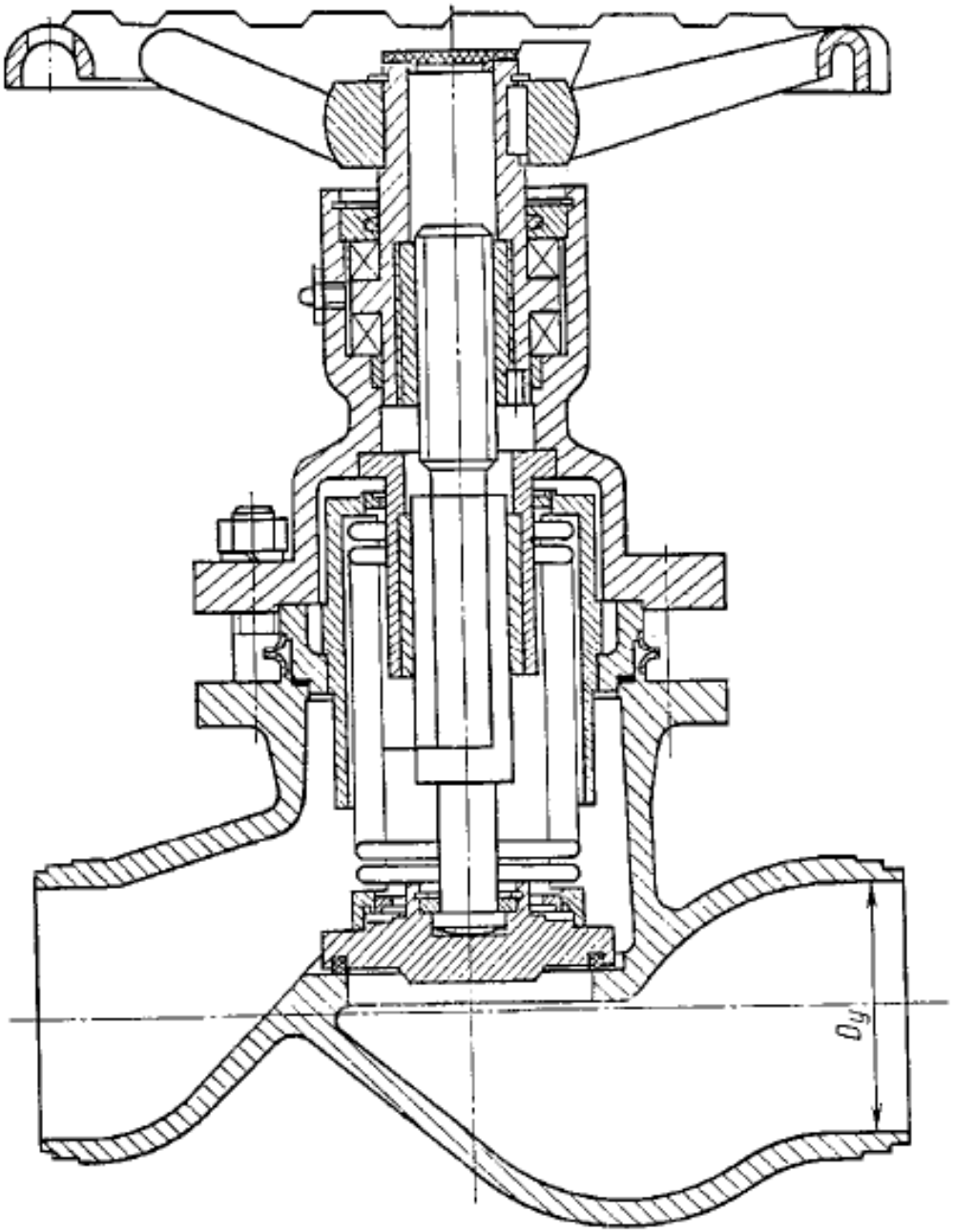
- Sealing type:
  - Bellows;
  - Diaphragm;
  - Hose;
  - Packing.
- Fittings of shut-off type:
  - Fastener (fitting where closing element moves perpendicularly to axis of moving substance);
  - Faucet (fitting where closing element moves according to central axis of sealing surface of casing – usually, normal to flow direction);
  - Valve (fitting where closing element moves at the same axis with flow).

FASTENER AND FAUCET



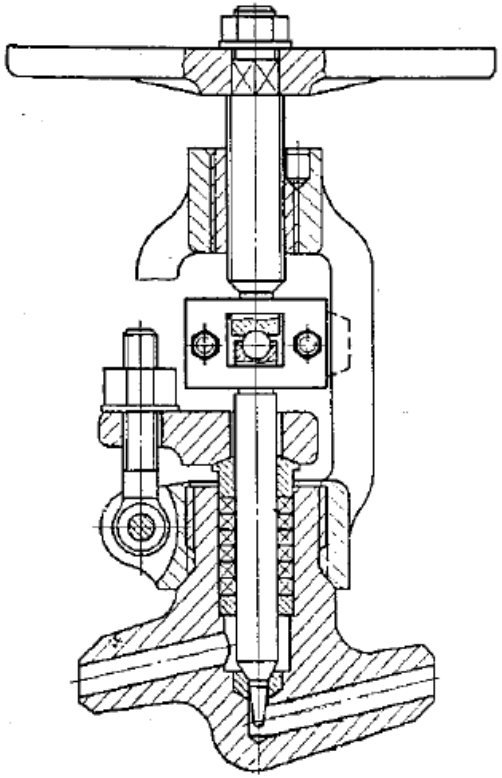


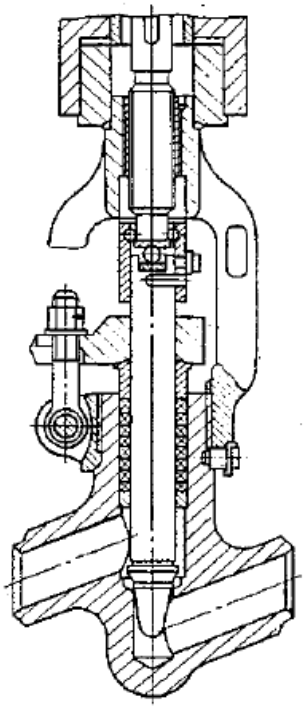




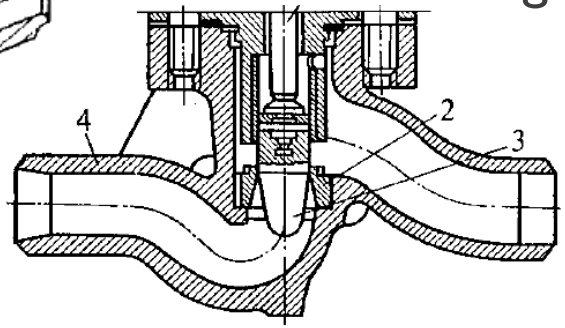
FAUCET OF BELLOW-TYPE

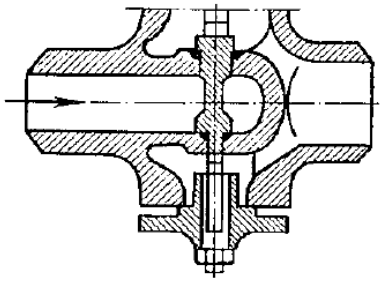
REGULATING FITTING



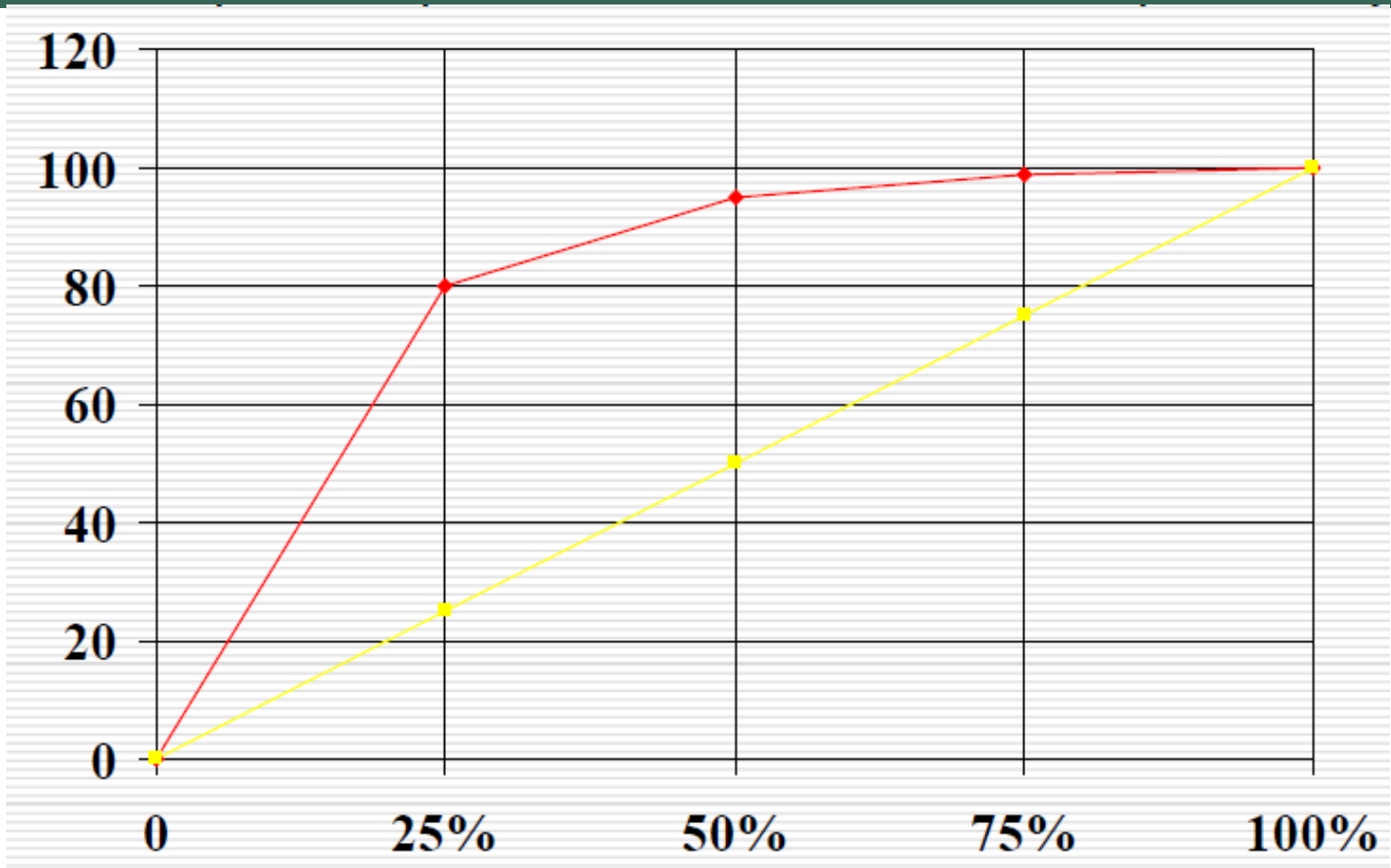


- Regulating fitting is designed to adjust parameters of working fluid.
- The needle-type fitting:
  - Regulating-type;
  - Throttling-type.

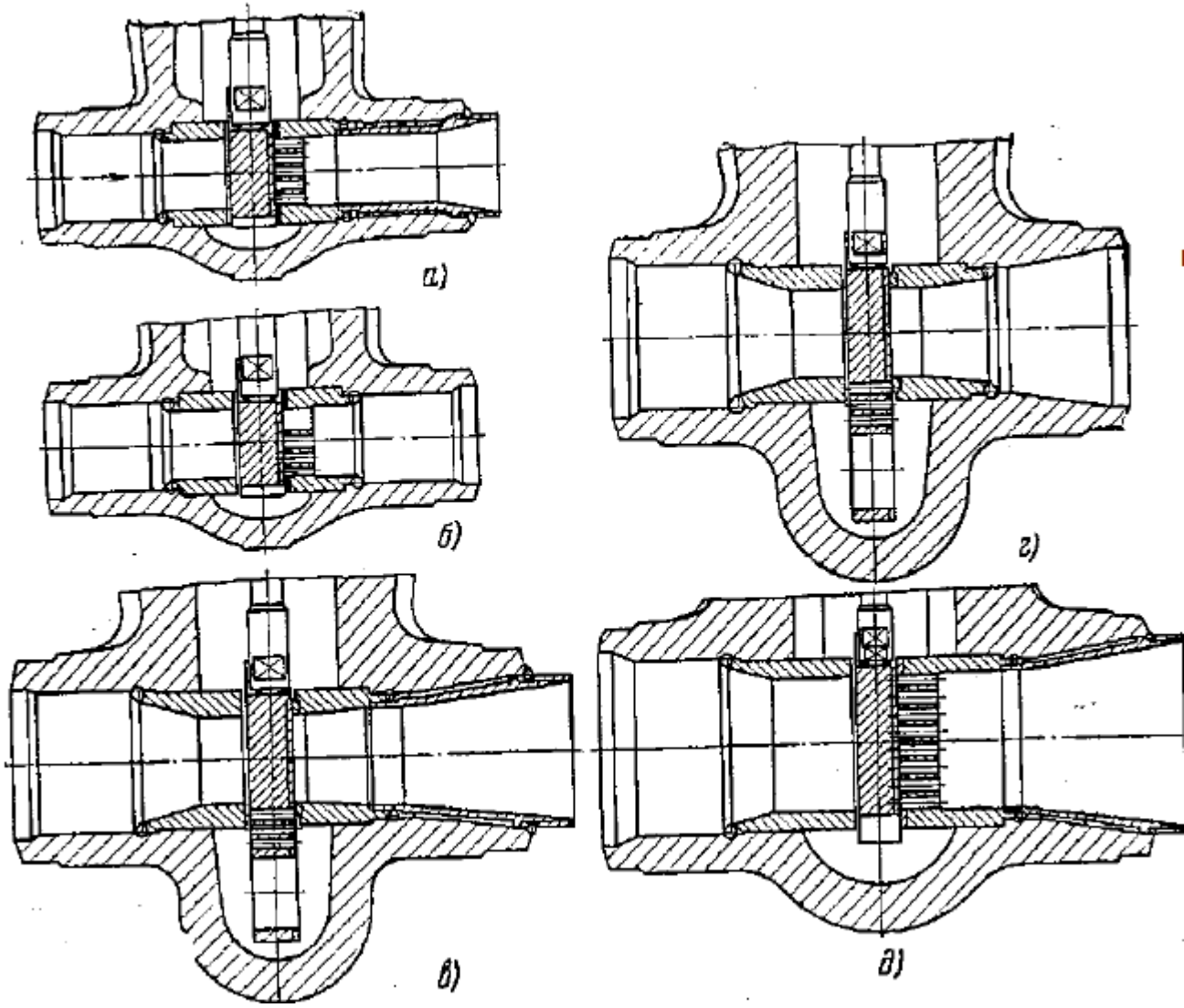




CHARACTERISTICS OF REGULATING AND SHUT-OFF FITTINGS



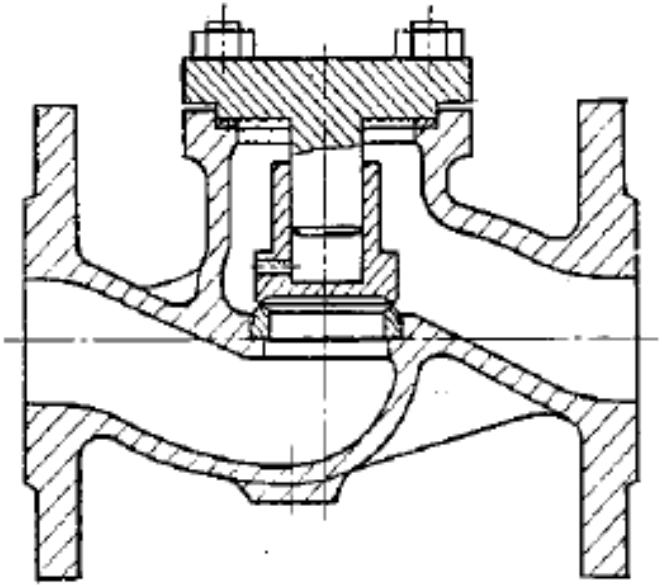
REGULATING AND THROTTLING VALVES

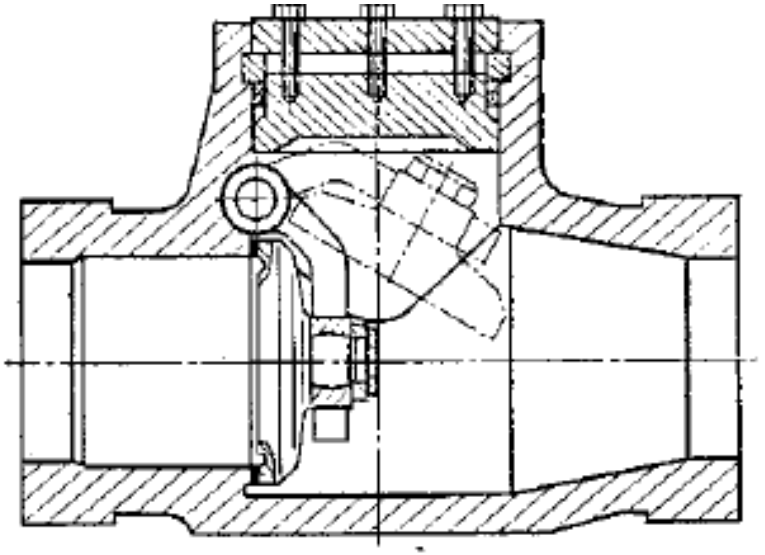


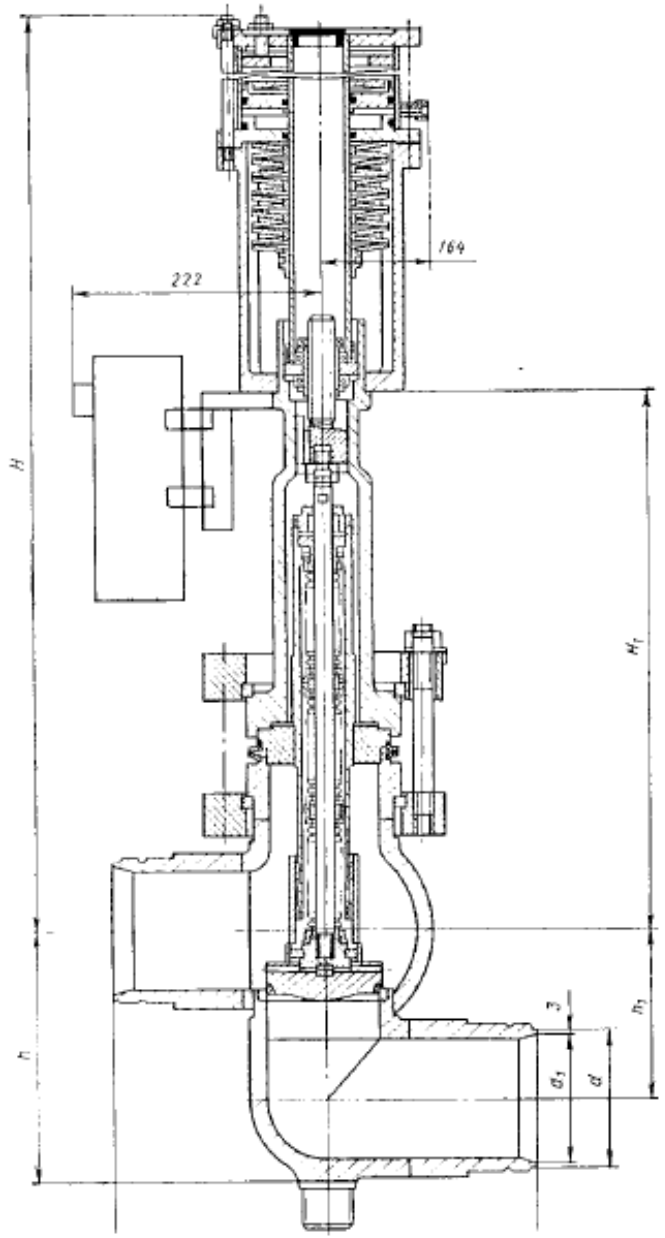
PROTECTIVE FITTING

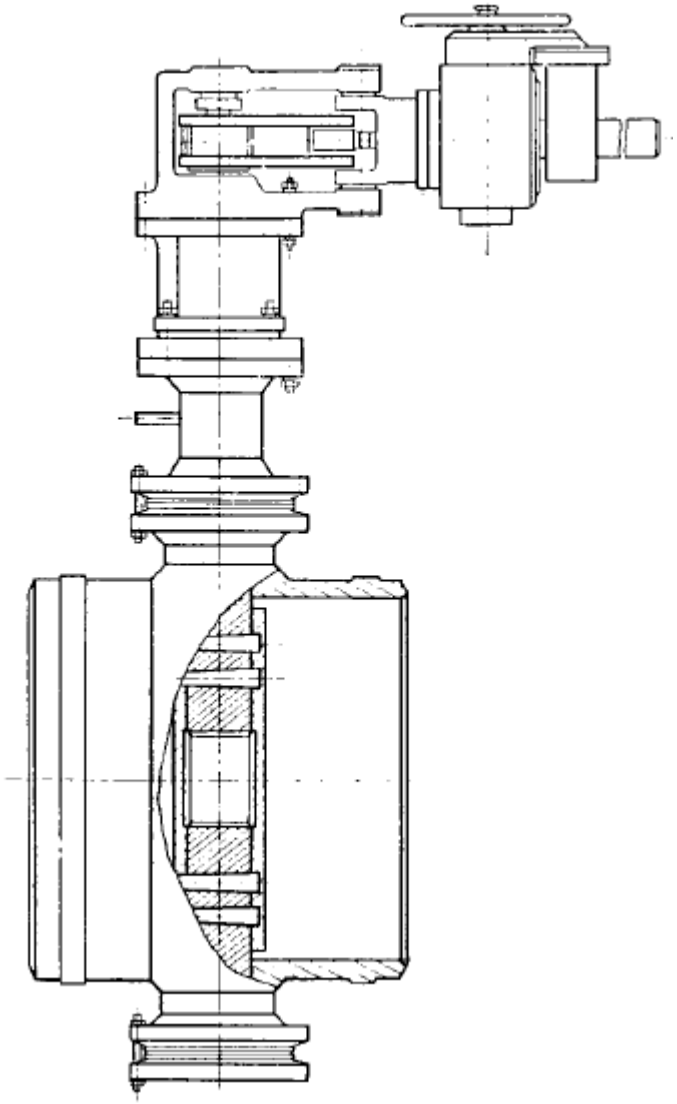
- Reverse valve (purpose – preventing of reverse flow of working fluid);
- Cut-off valve (purpose – preventing fluid from leaving pipeline with high speed);
- Membrane valve (purpose – preventing high pressures by breaking special membrane);
- Safety valve (purpose – letting fluid out from pipe to decrease pressure).

Main difference of safety valve – restoring of exploitation after action.





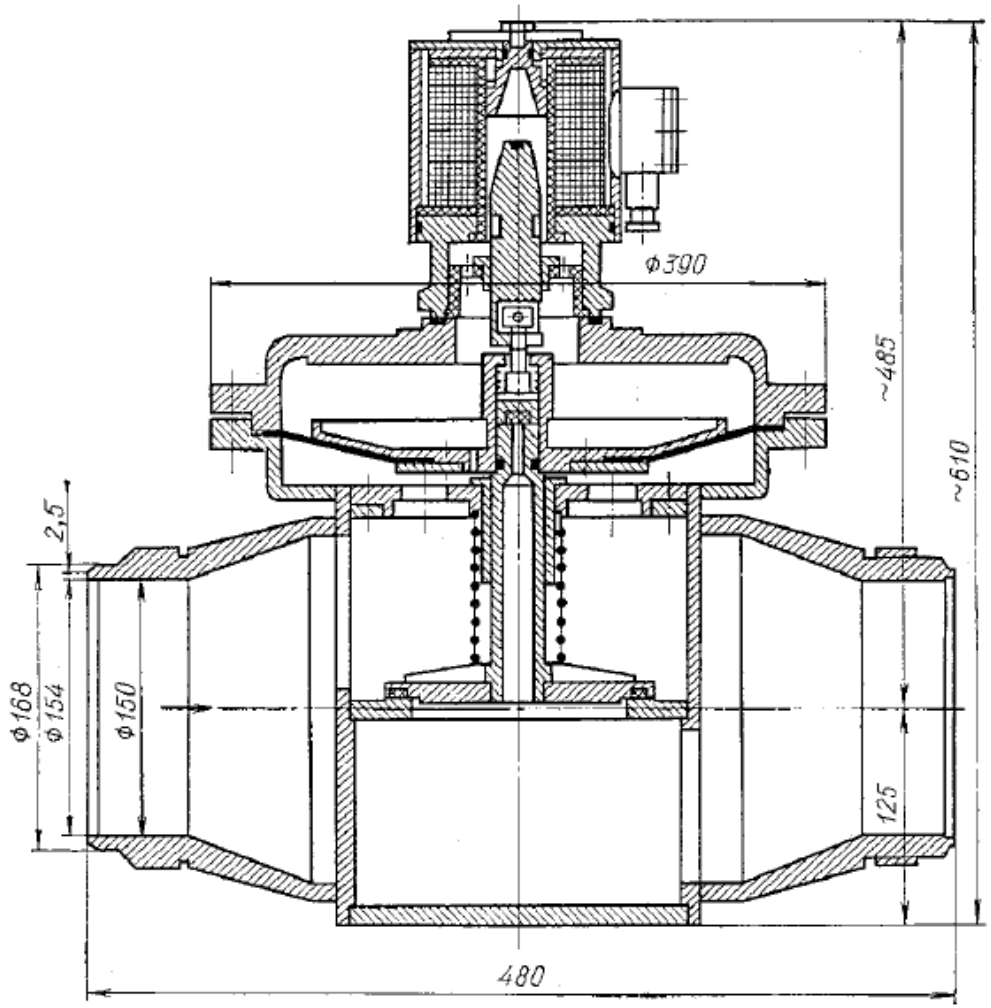




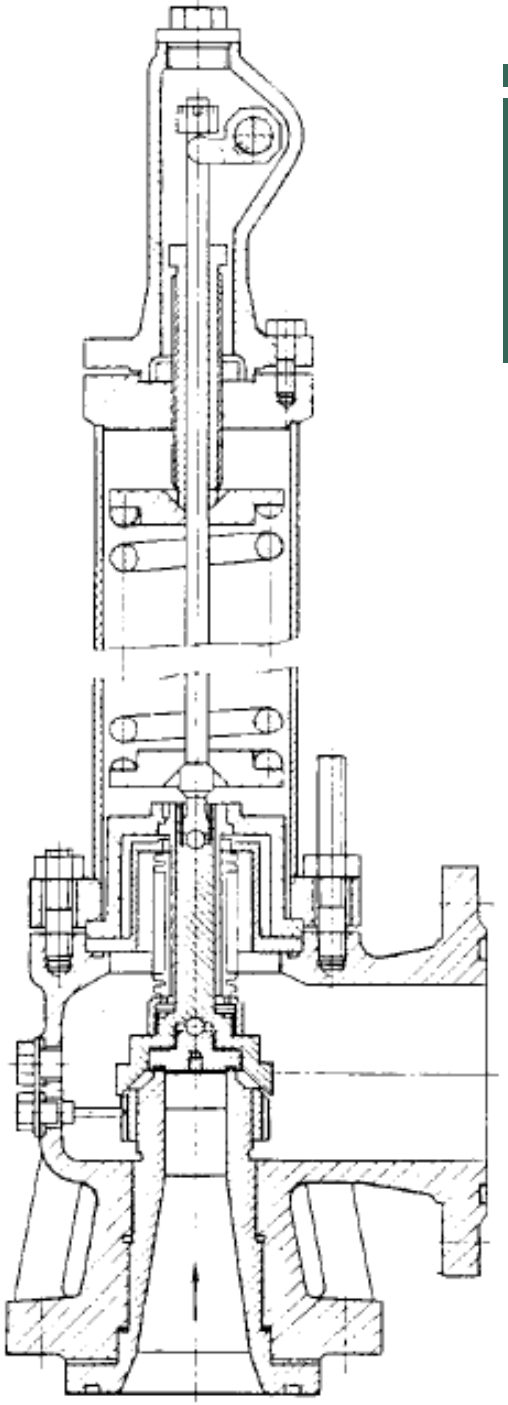
BELLOWS-TYPE

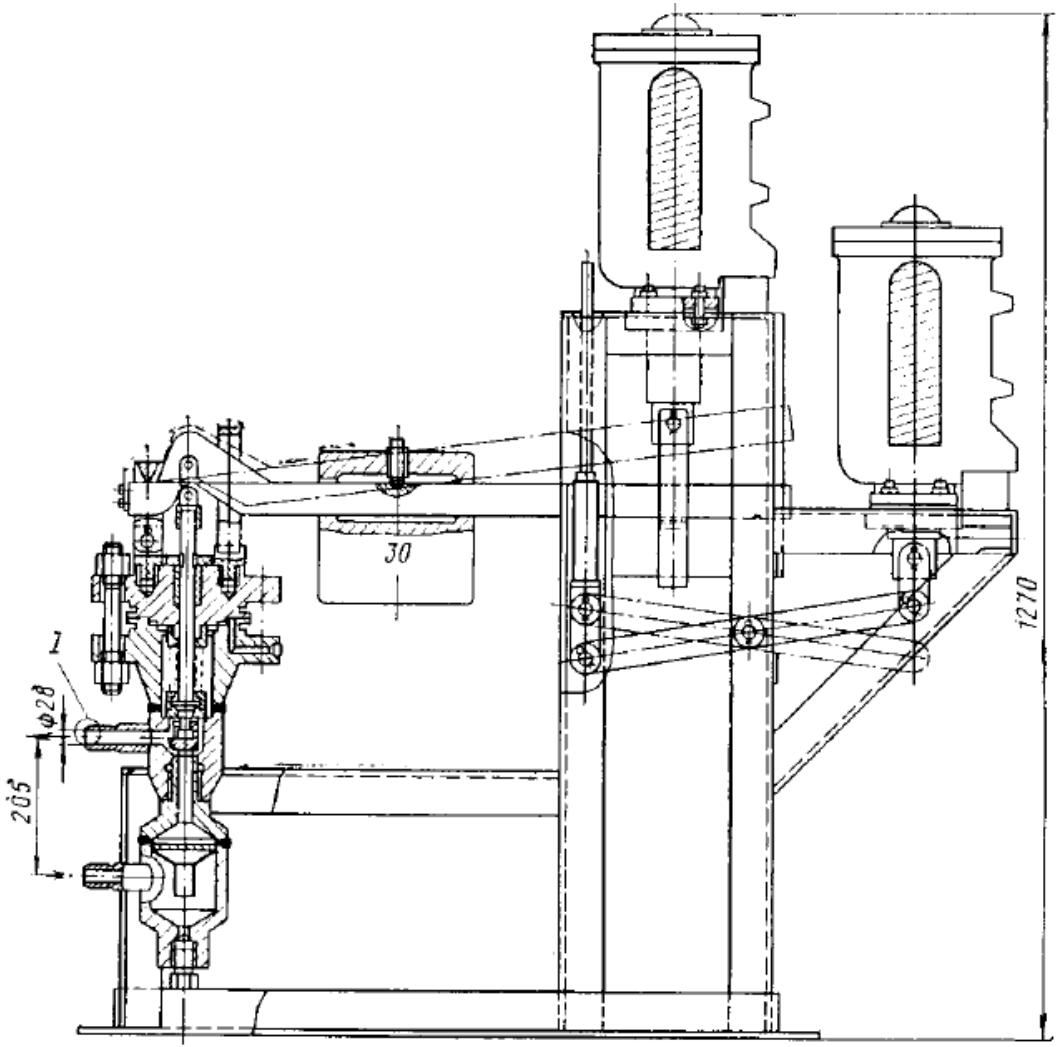
THROTTLING-TYPE

PROTECTIVE FITTING OF MEMBRANE-TYPE

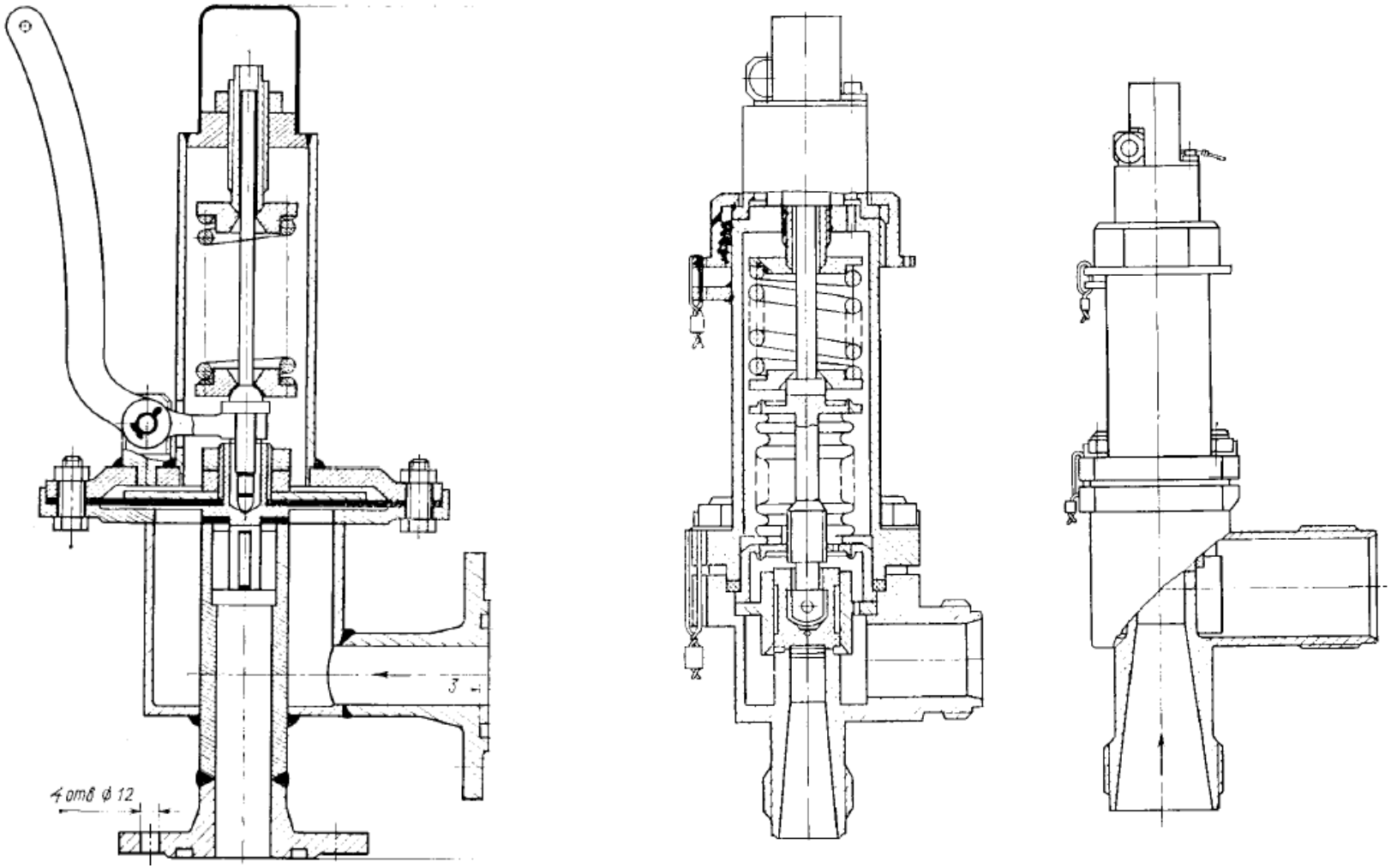


PROTECTIVE FITTING





PROTECTIVE FITTING



GENERAL INFORMATION ABOUT PIPELINES AND CLASSIFICATION

- **Purpose** – connection of different equipment.
- **Total length** – tens of kilometers.
- **Cost** – up to 10 % of general cost of equipment.

Classification

- By purpose (type of fluid):
  - Main circulation circuit;
  - Feed water;
  - Condensate;
  - Steam;
  - Drainage;
  - Etc.
- By parameters of fluid:
  - Pressure;
  - Temperature.
- By radioactivity:
  - High/medium/low;
- By periodicity of exploitation:
  - Permanent;
  - Periodical.

FEATURES OF PIPELINES OF NPP

- The seamless pipes are used (very rare – wielded pipes).
- All pipelines with temperature >45 °C have thermal isolation.
- Pipelines are mounted using bearings.
- Pipelines are characterized by diameter and thickness of the wall: $d \times \delta$, - as well as by nominal pressure, nominal cross-section area and steel type.
- Difference between nominal and working pressure:
  - Nominal pressure – pressure which allows to ensure sustainable exploitation with fluid temperature 20 °C.
  - Working pressure – pressure which allows to ensure sustainable exploitation with working fluid temperature.
- Nominal diameter – nominal internal diameter expressed by integer number (6, 8, 10, 15, 20, 25, 32 … 80, 100, 125, … 1000, 1200, 1400, … 4000).

MATERIAL OF PIPELINES

- Carbon steels 10 and 20 (at temperatures less than 450 °C);
- Perlitic steel like 12C1MV and 15C1M1A (used at temperatures 450-570 °C);
  - Cr – 0,5-2 %; Mo – 0,3-1 %;V – 0,2-0,4 %.
- Martensitic-ferrite steel like EI-756 (used at temperatures below 620 °C);
  - Cr – 11 %; Mo – 0,2 %;V – 0,7 %.
- Austenitic steel like C18N10Ti (used at temperatures below 700 °C).

- Effect of different additives:
  - **Mo** – increases durability and corrosion resistance;
  - **Cr** – increases heat resistance of cheap allows;
  - **Ni** – promotes austenization of alloys, increases yield limit;
  - **W** – increases heat resistance;
  - **V** – increases durability.

ADVANTAGES AND DISADVANTAGES OF AUSTENITIC ALLOYS

Advantages

- Good mechanic properties.
- Good corrosion and erossion resistance.
- Good wielding properties.

Disadvantages

- High cost (cost relation of carbon/ perlitic/ austenitic allows is close to 1:2,5:15).
- Low thermal conductivity.
- Liability to corrosion of different types.

CHARACTERISTIC VELOCITIES OF FLUID ON NPP

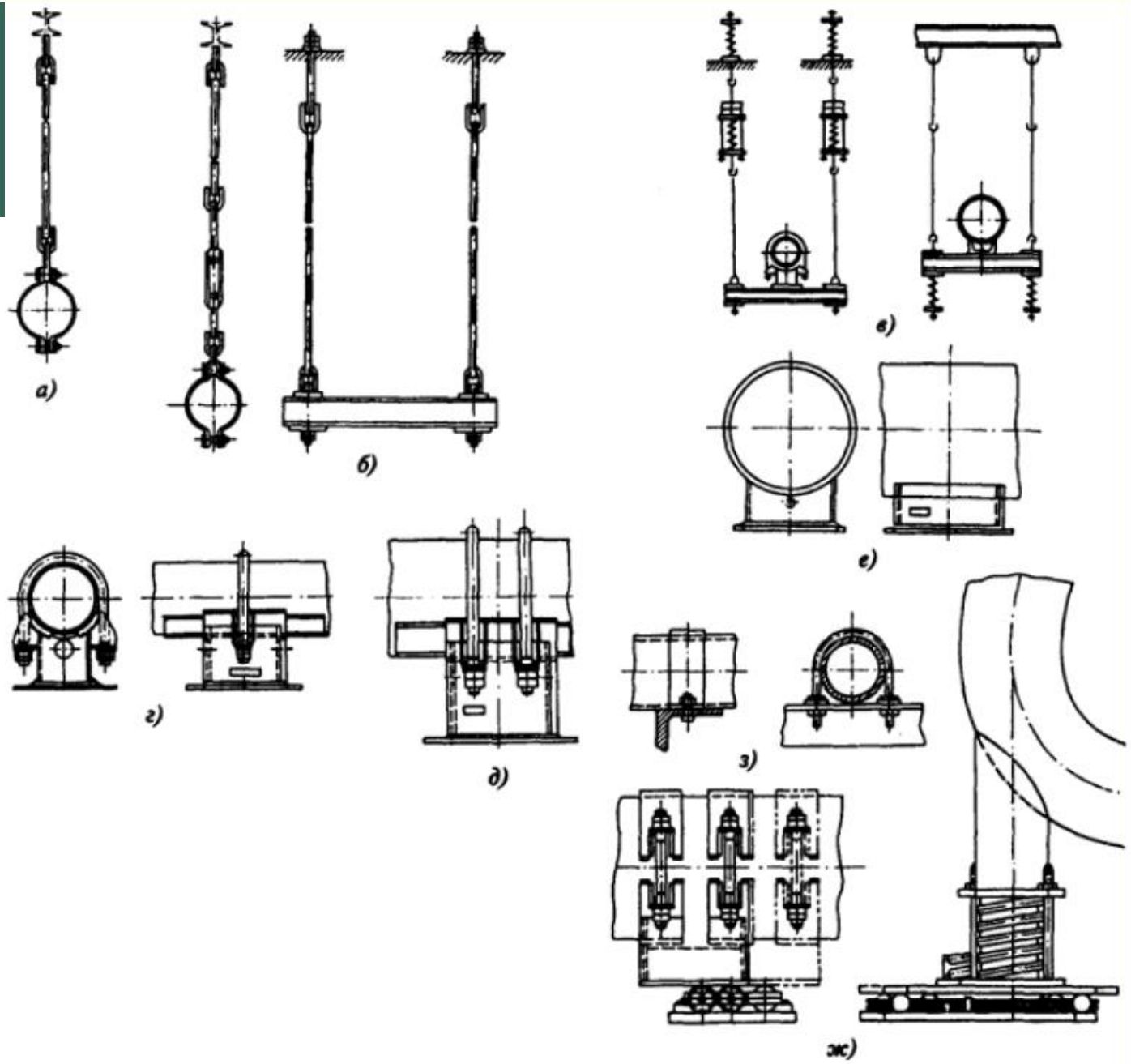
Fluid type	Velocity, m/s	Pipe material
Fresh steam	45-50	
Low pressure steam	50-70	
Feed water	4-6	Carbon steel
	8-12	Stainless steel
Condensate	2,5-4	
Gases	10-20	

TECHNIC-ECONOMIC ANALYSIS OF PIPELINES

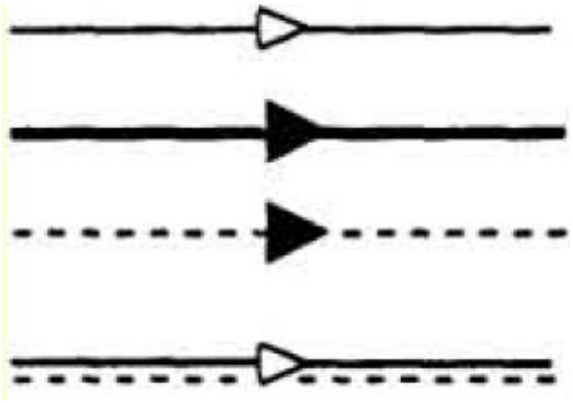
- Algorithm:
  - Defining of the inner diameter using preset value of velocity.
  - The wall thickness is defined using working pressure.
  - The standard pipe with closest parameters is chosen.

- Decreasing of pipe diameter results into:
  - Decreasing weight and cost of pipeline;
  - Increased velocity of fluid;
  - Increased pressure losses.

BEARINGS AND HANGERS



IDENTIFICATION OF PIPELINES



fresh and bleed steam

main condensate and feed water

condensate of heating steam

air-steam mixture

THANK YOU FOR YOUR ATTENTION