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CONSTRUCTIONAL METHODS OF INCREASING THE PLASTICATING EFFICIENCY

Lublin, 27 January 2017, NEWEX project

METHODS of increasing the efficiency of plasticating

Technological

- Rotational screw speed
- Temperature distribution along the length of the plasticizing unit

Constructional

- Screw construction
- Barrel construction

- diameter of the screw
- pitch of the screw
- number of helical lines
- channel height
- channel width
- taper angle of the helical line

SCREW CONSTRUCTION

Elements of intensive mixing and shearing

EFFECTS

- **Improvement of polymer homogenization**
- **Increase of polymer temperature**
- **Decrease of polymer pressure**
- **Decrease of output rate**

All on short length of plasticizing unit

LOCATION

- Melting and metering zone
- Screw end
- Between the plasticizing unit and die

MIXING ELEMENT

PIONEER

C. Maillefer, 1960

CALLING NAME

Barrier flight

IDEA

Increase of mixing in the polymer flow through forced:

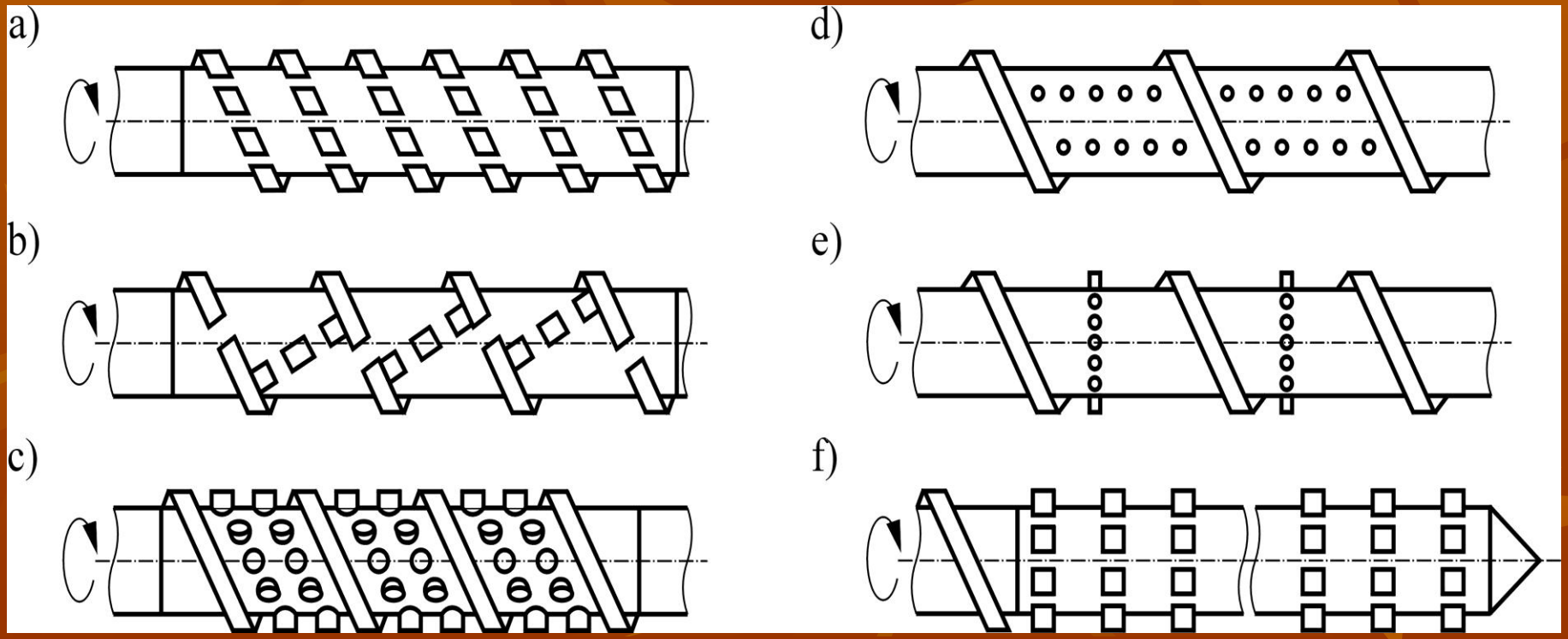
- Separating and joining of polymer flows
- Rotation of polymer flows

Mixing always together with shearing

SOLUTIONS

Constructional forms

→ classical



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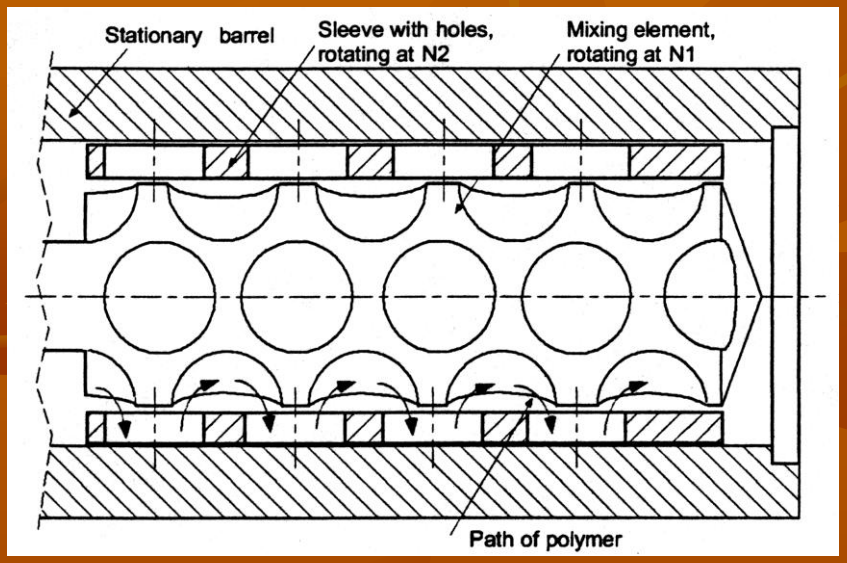
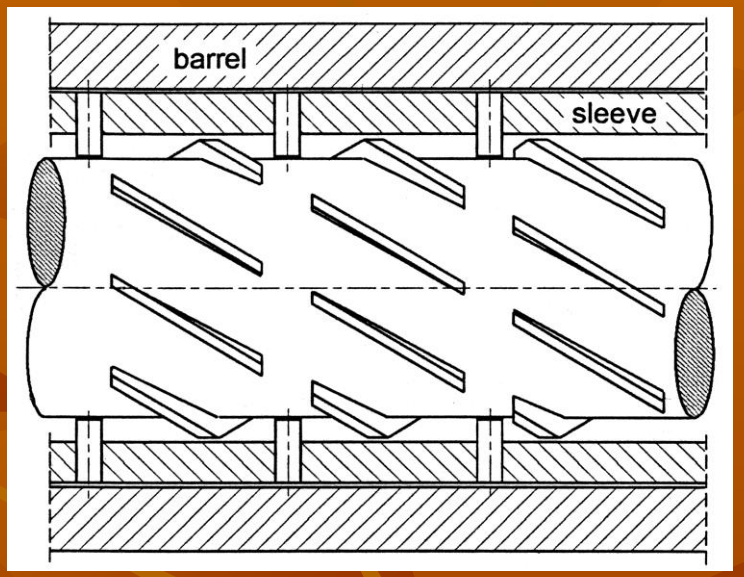
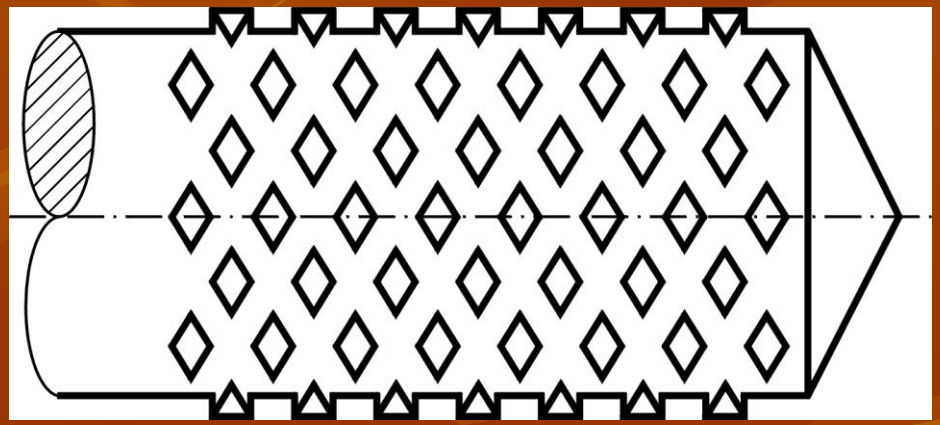


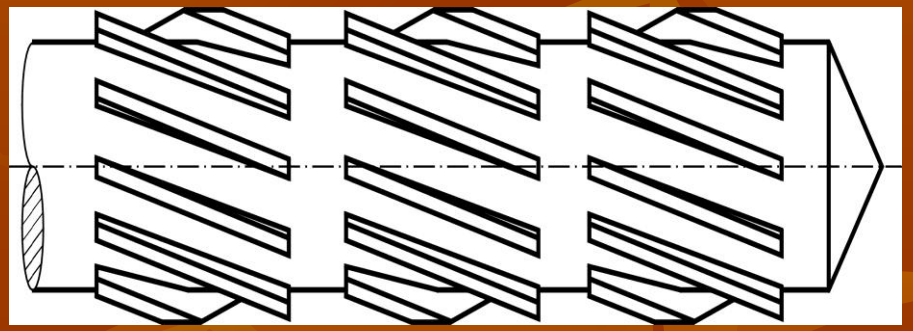
Semmekrot's element



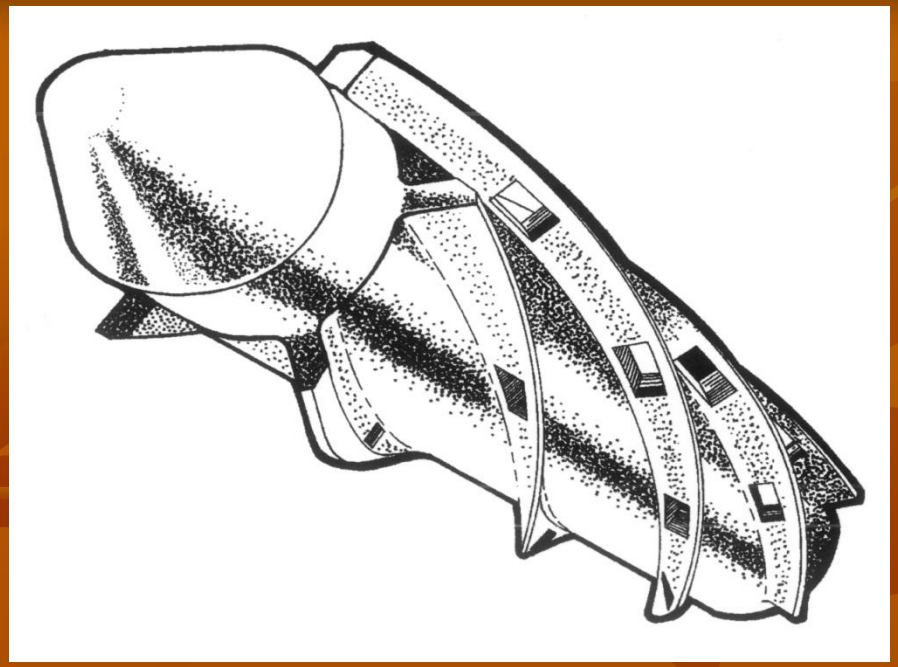
Saxton's element



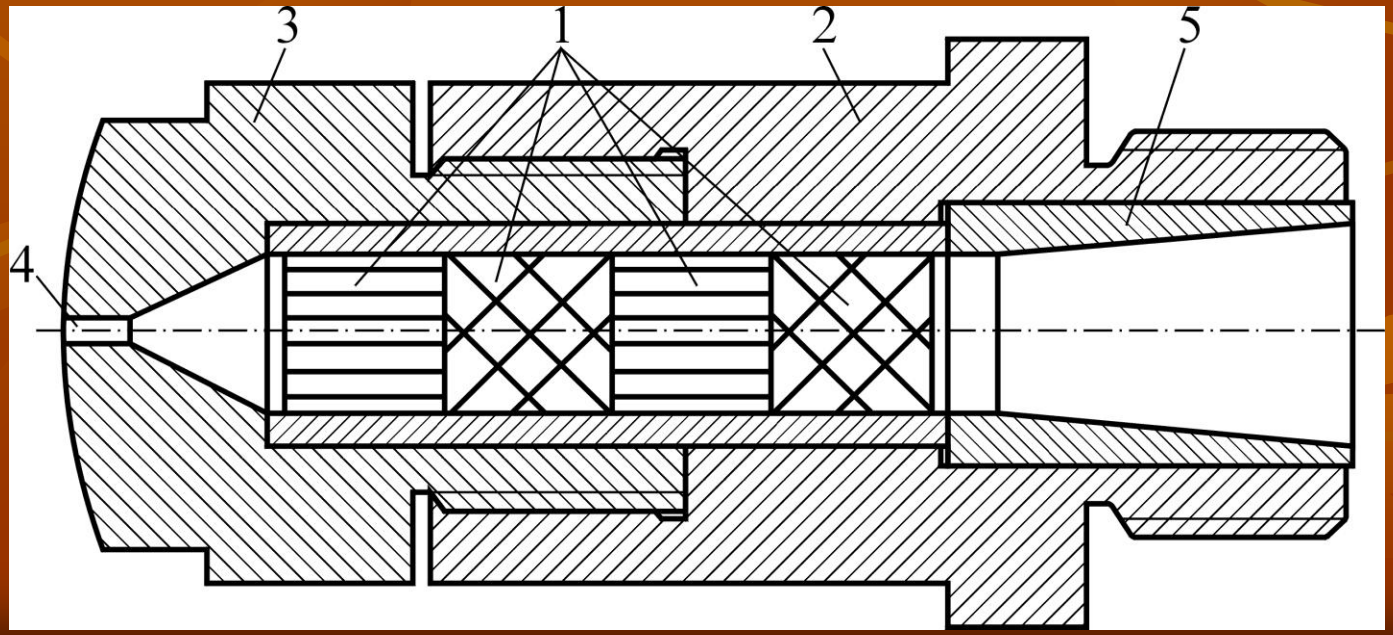
Pineapple's element



Dulmage's element



1 – mixer components – rods, 2 – back die body, 3 – front die body, 4 – die channel, 5 – joining sleeve



SHEAR ELEMENT

PIONEER

G.H. LeRoy and B. H. Maddock,

1967 „Union Carbide”, USA

CALLING NAME

Maddock ring

IDEA

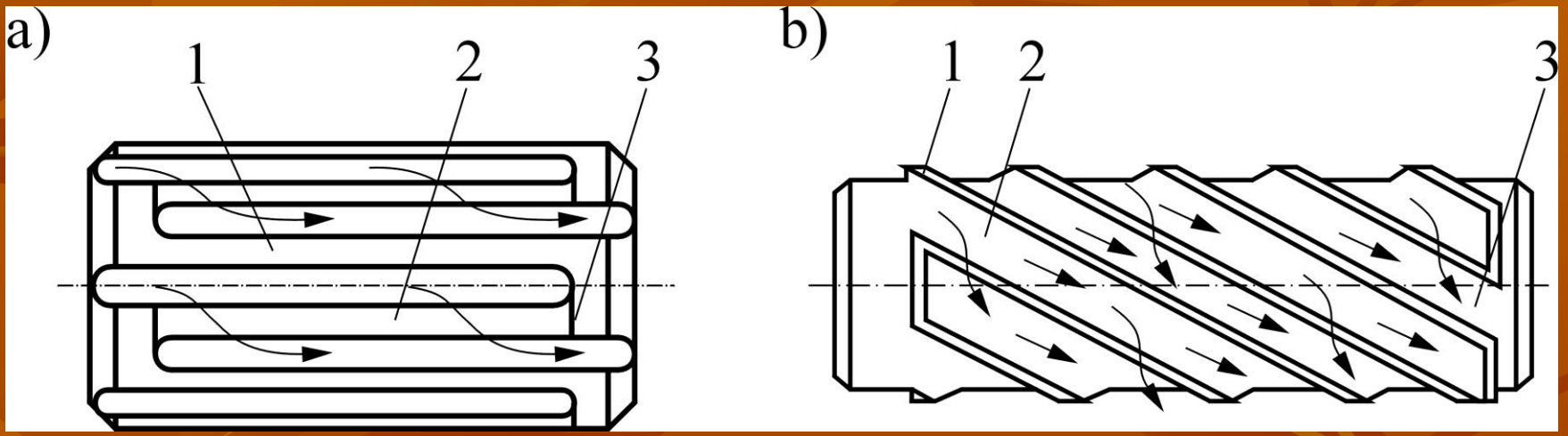
Increase of shear in polymer flow through forced gap flow

Shear occurs always together with mixing

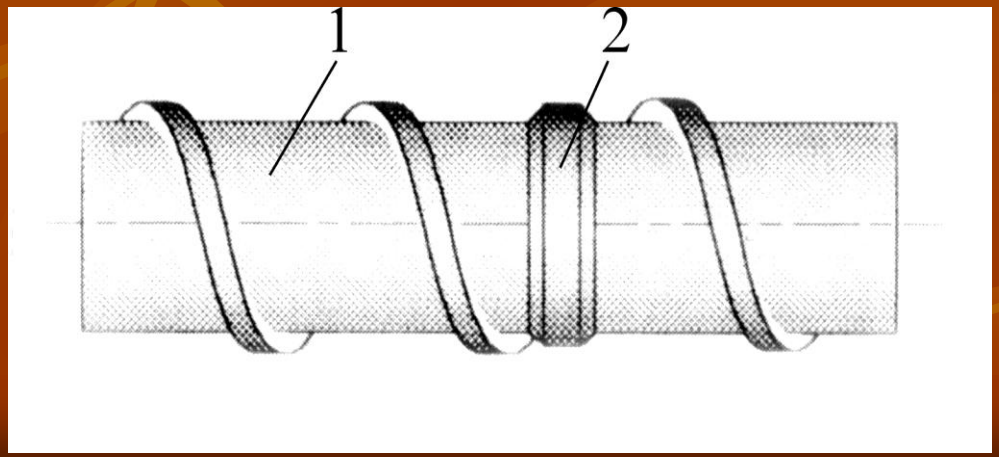
SOLUTIONS

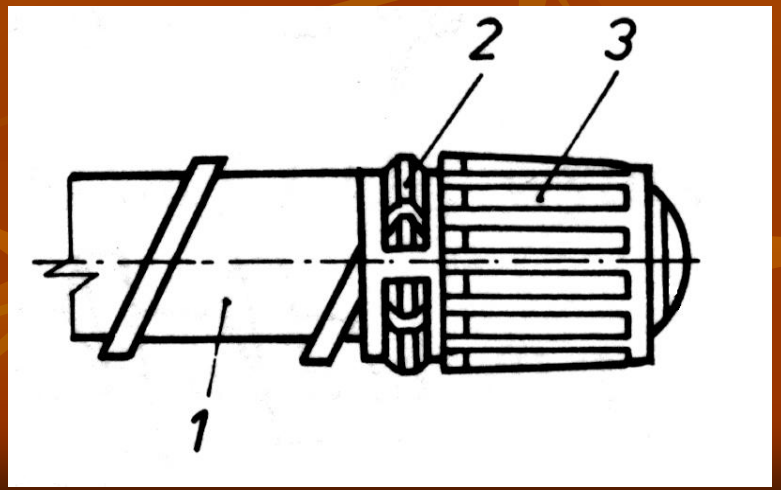
Constructional forms

→ classical: rings with longitudinal or helical grooves



→ modified: short barrier rings





Additional barrier flights

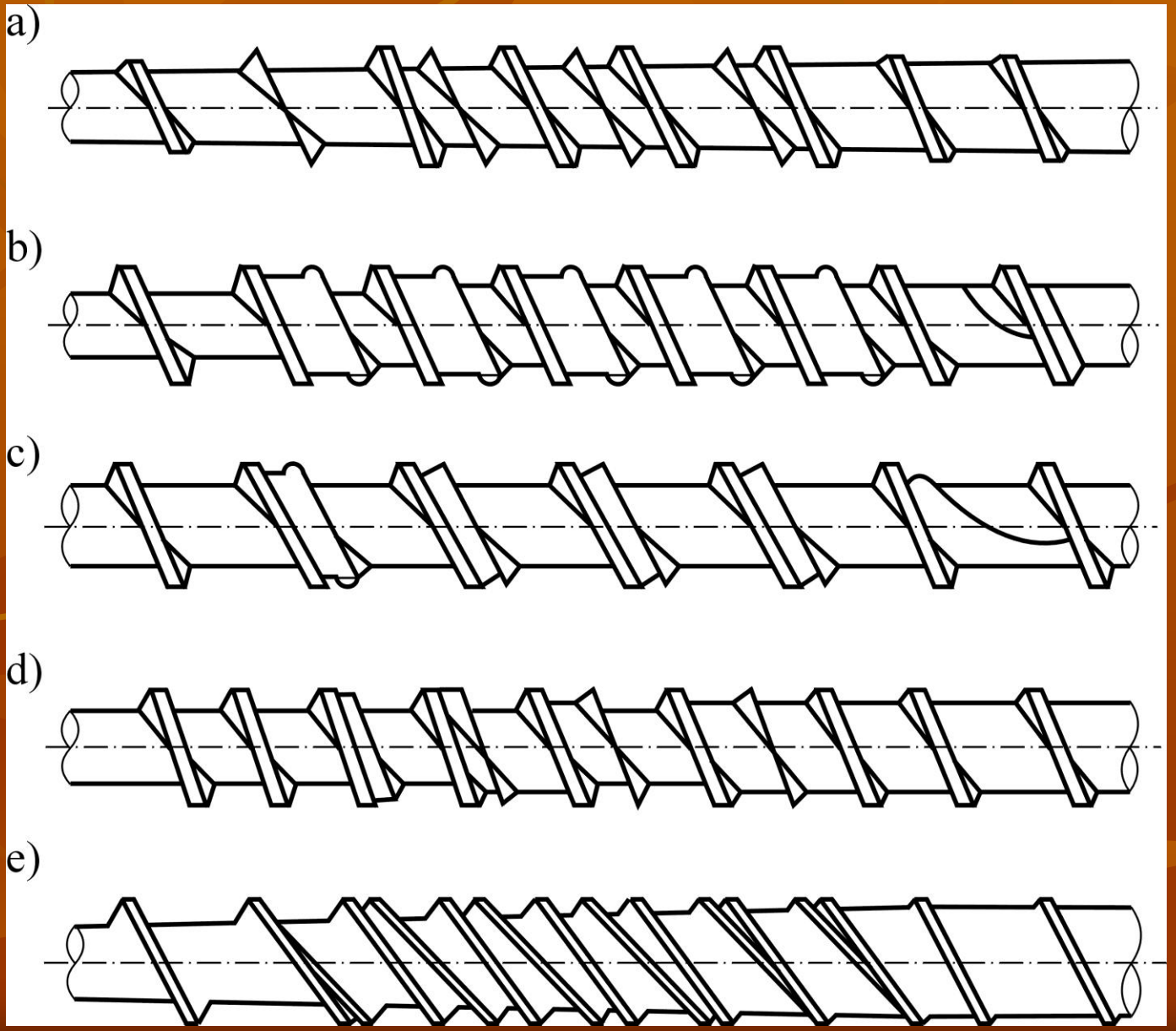
a) Maillefer screw,

b) Barr screw,

c) Dray screw,

d) Kim screw,

e) DFM screw



BARREL CONSTRUCTION

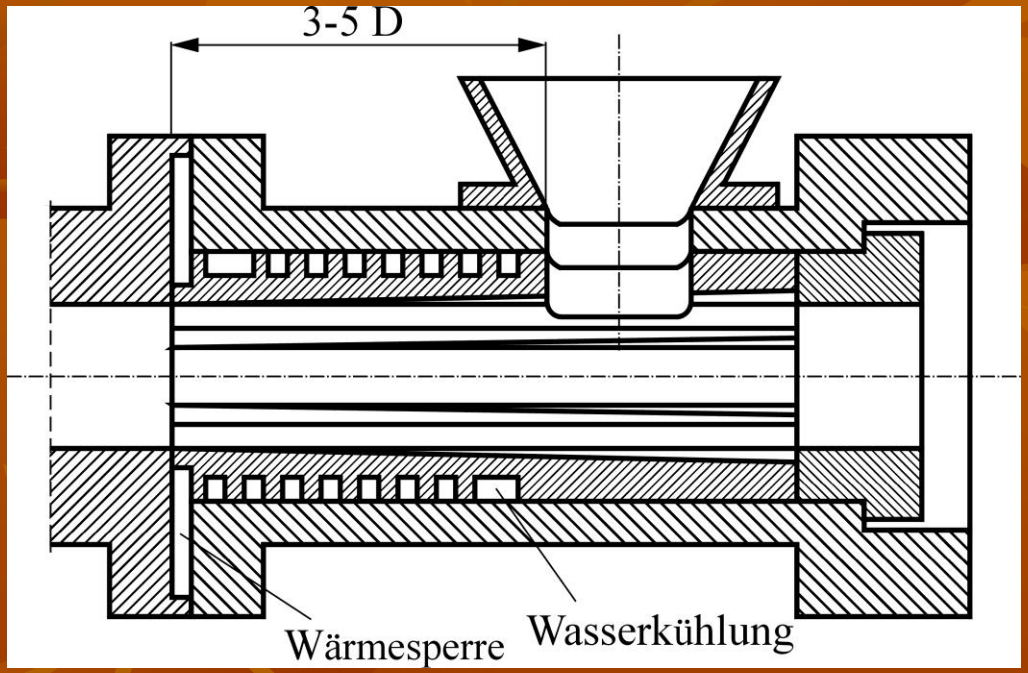
EFFECTS

- **Increase of output rate**
- **Increase of polymer pressure**
- **Increase of polymer temperature**

All on short length of plasticizing unit

PIONEER

G. Fuchs, 1968, „Badischen Anilin & Soda-Fabrik AG”, Germany



CALLING NAME

Grooved feed section

IDEA

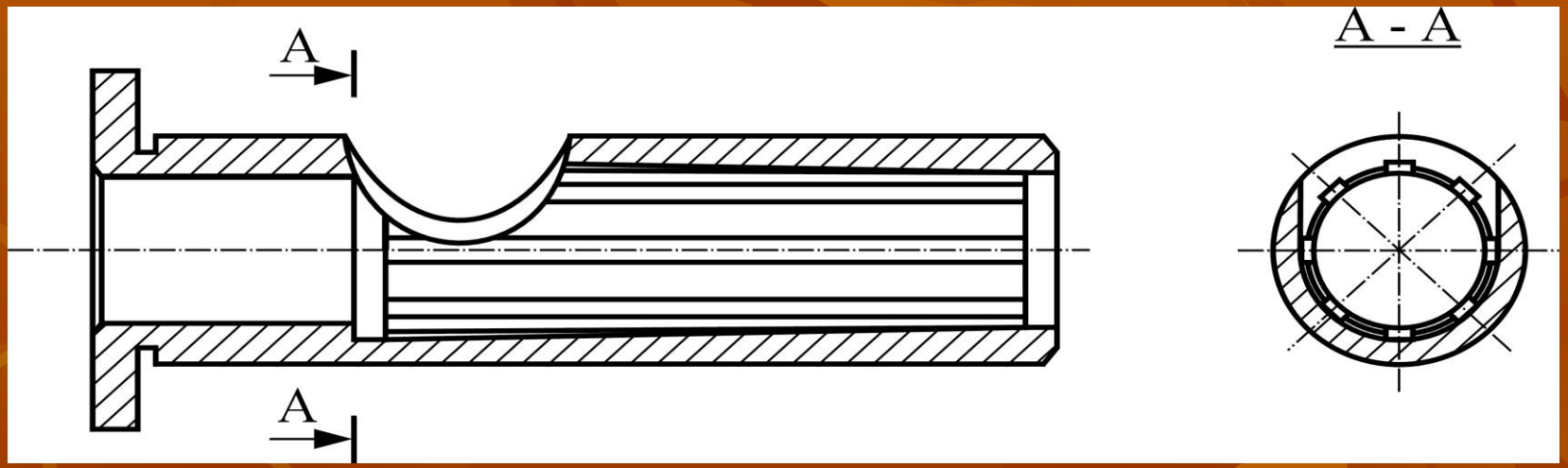
Increase of polymer friction in the feeding zone through polymer forced movement along the grooves

SOLUTIONS

Constructional forms

- **Passive grooved feed section**

(grooved feed section in which constructional features are constant during the extrusion process)



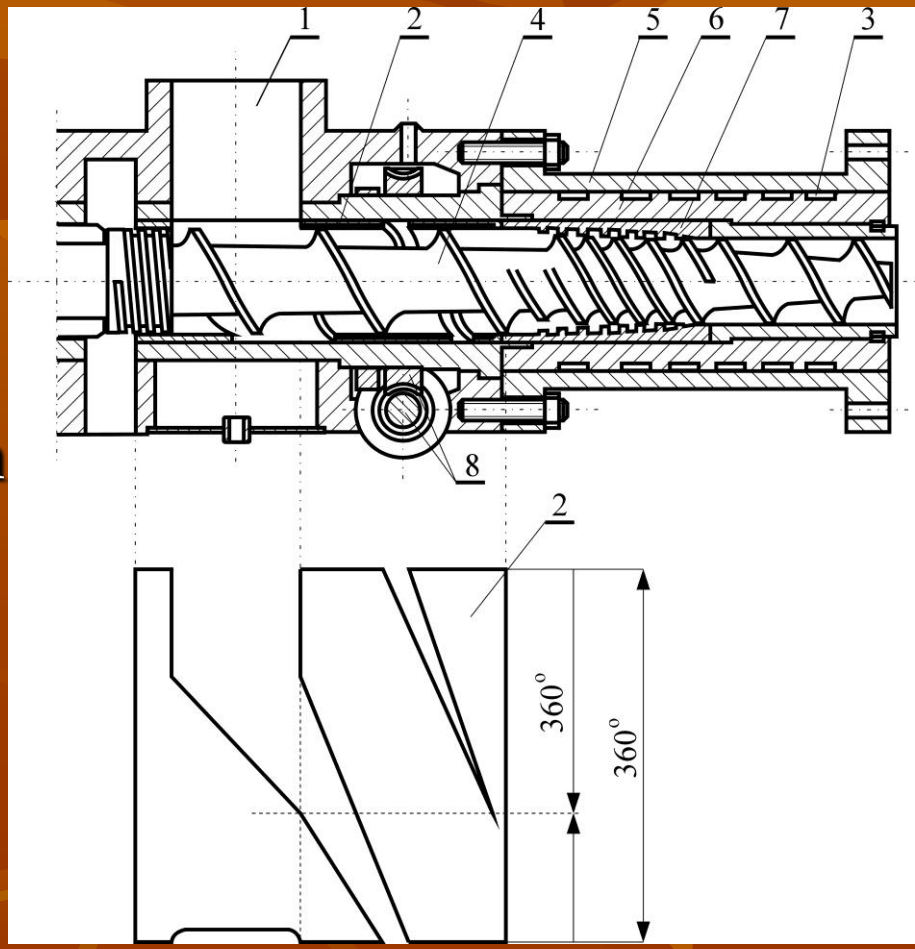
- **Active grooved feed section**

(possibility to change the constructional features during the extrusion process)

- **Active grooved feed section**

Parameters of active grooved feed section:

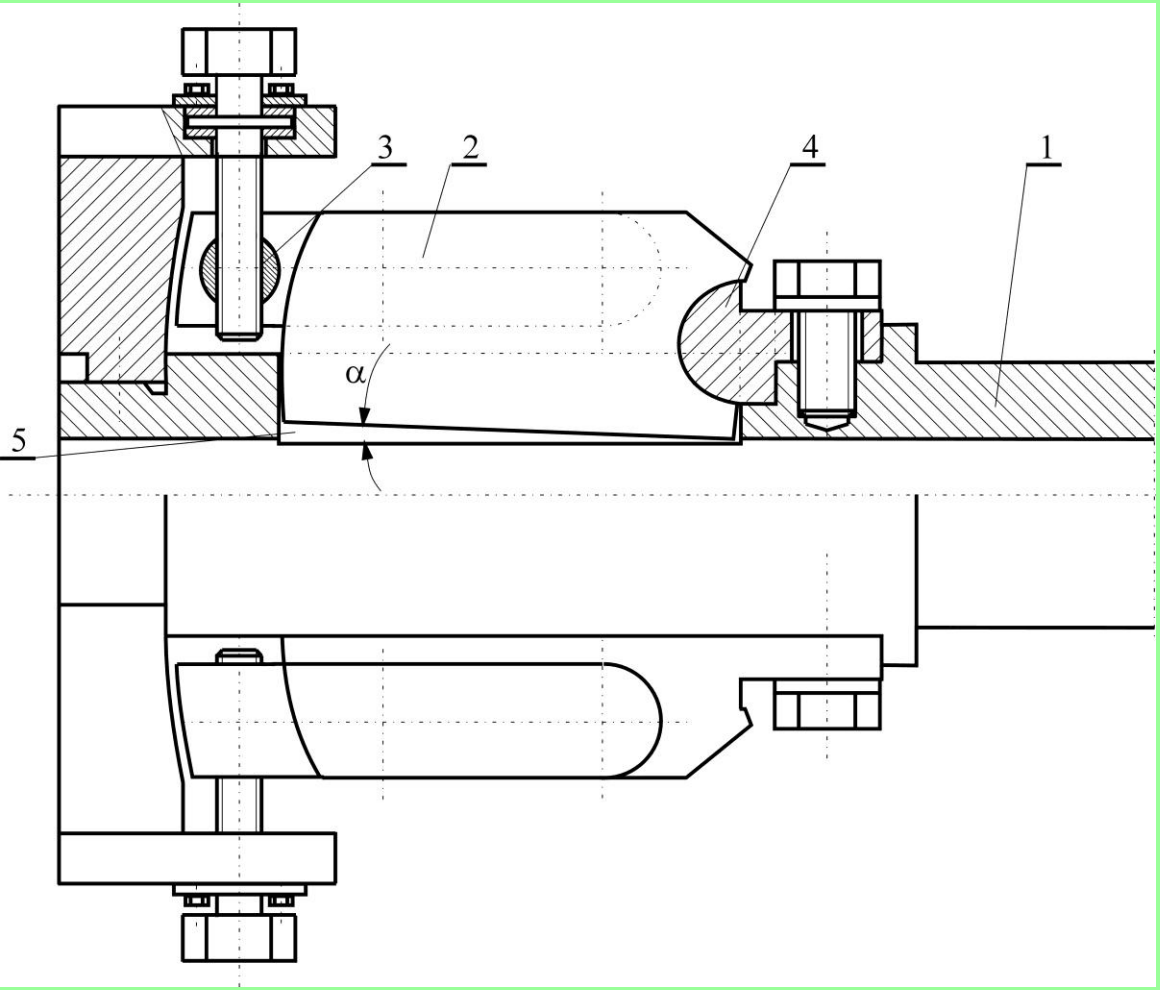
- Number of grooves,
- Taper angle,
- Depth of grooves,
- Direction of grooves torsion,
- Torsional angle,
- Shape of grooves cross-section



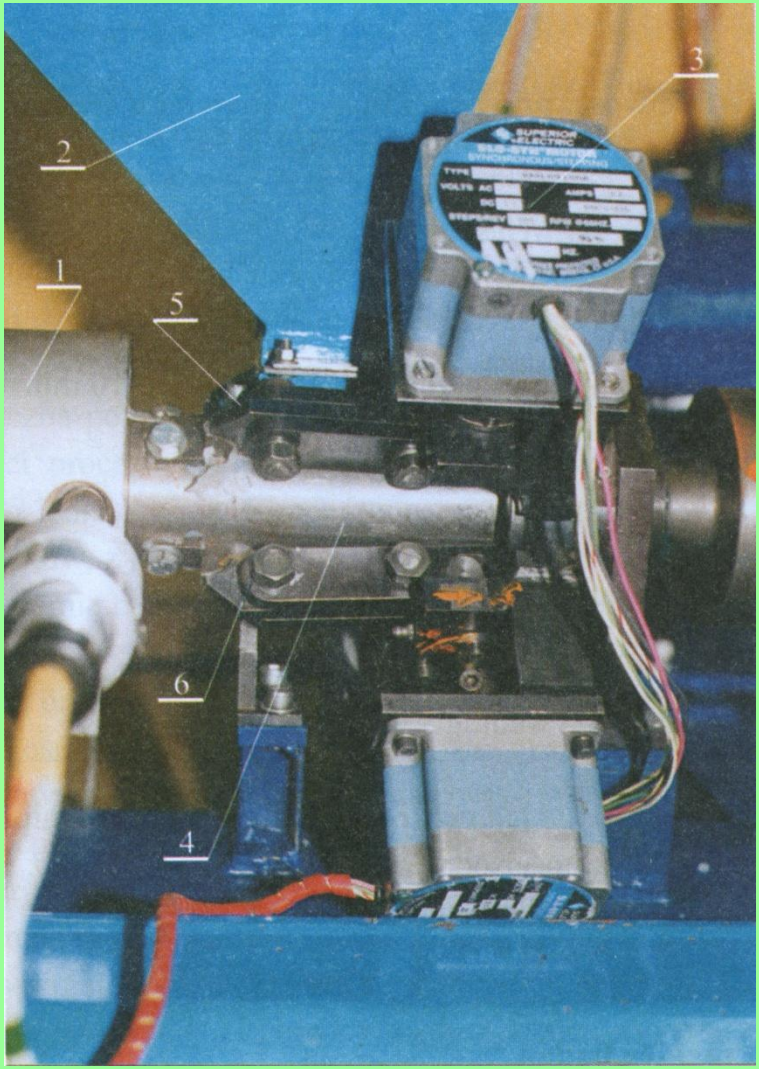
PIONEER

P. Meyer, 1983, USA Patent No 4 462 692

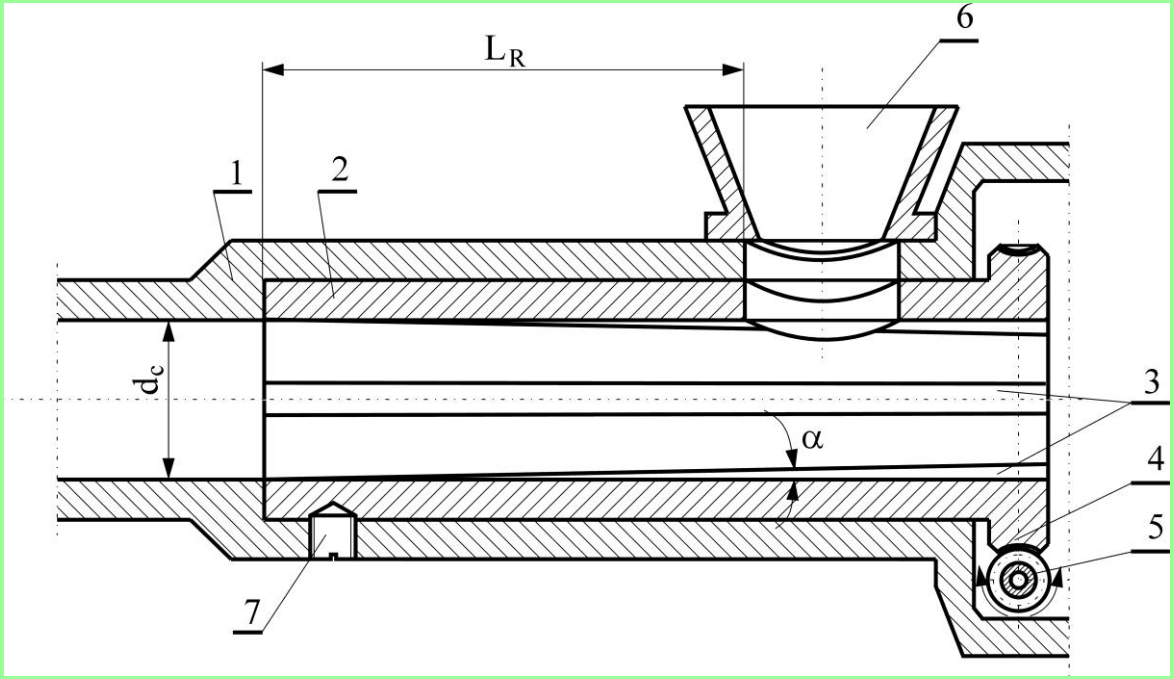
There are few patents, most of them from the USA



Longitudinal section of grooved feed zone



Grooved feed zone


L_R
6
1
2
d_c
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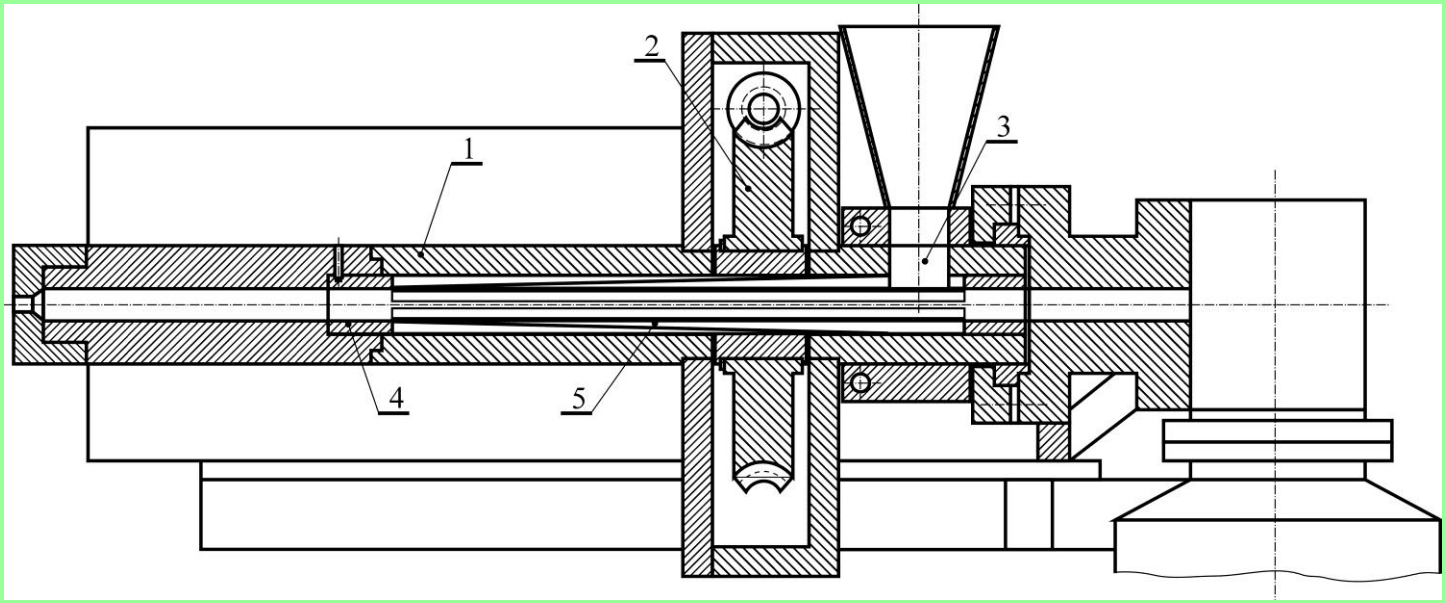
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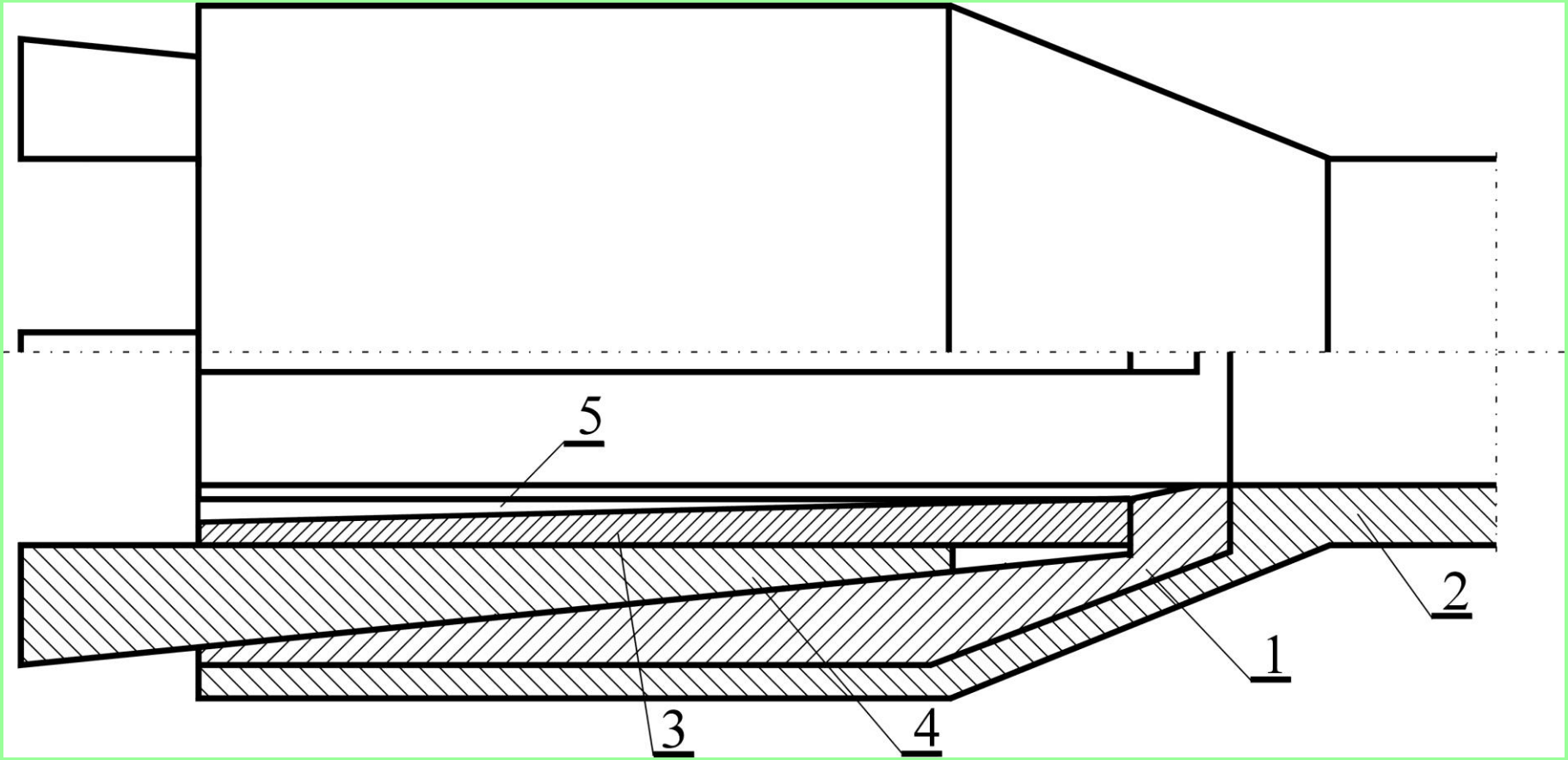
5
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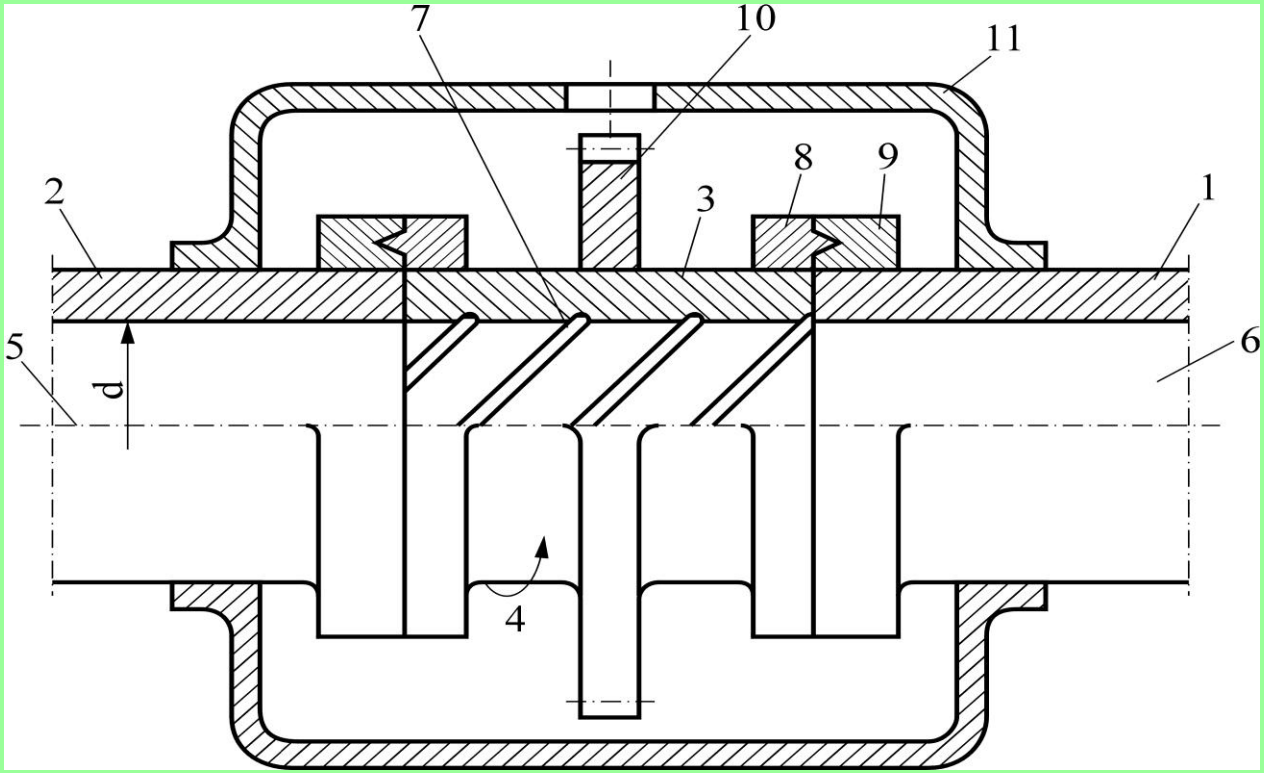
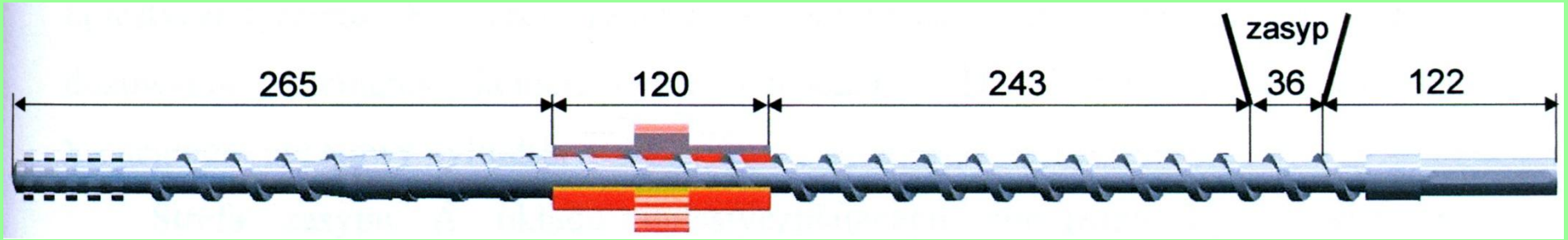
The latest concept of increasing the efficiency



Rotational barrel segment

Location: in the melting zone, where most heat is needed



THANK YOU
FOR YOUR ATTENTION