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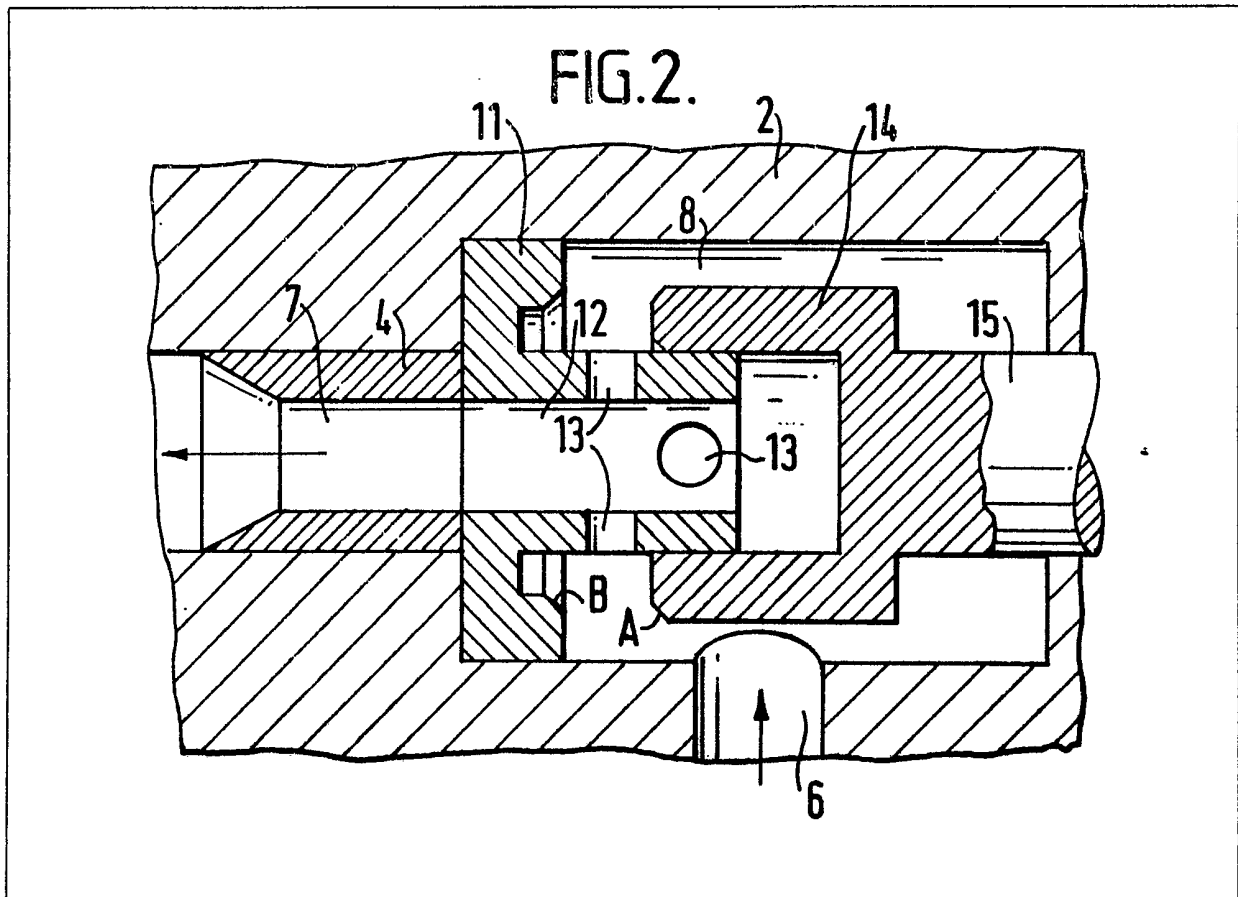
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(54) Fluid flow choke

(57) A choke is provided having a stationary tubular flow nozzle 11 with

throttling ports 13 formed through its side wall. A movable tubular throttling ring 14 may be moved over the nozzle 11 to restrict or close the ports 13. A liquid-tight seal or shut-off is obtained with annular seal surfaces A, B formed on the nozzle 11 and ring 14 remote from and upstream of the ports 13, so that erosion of these seal surfaces A, B, by the high velocity streams passing through the ports, is minimized.

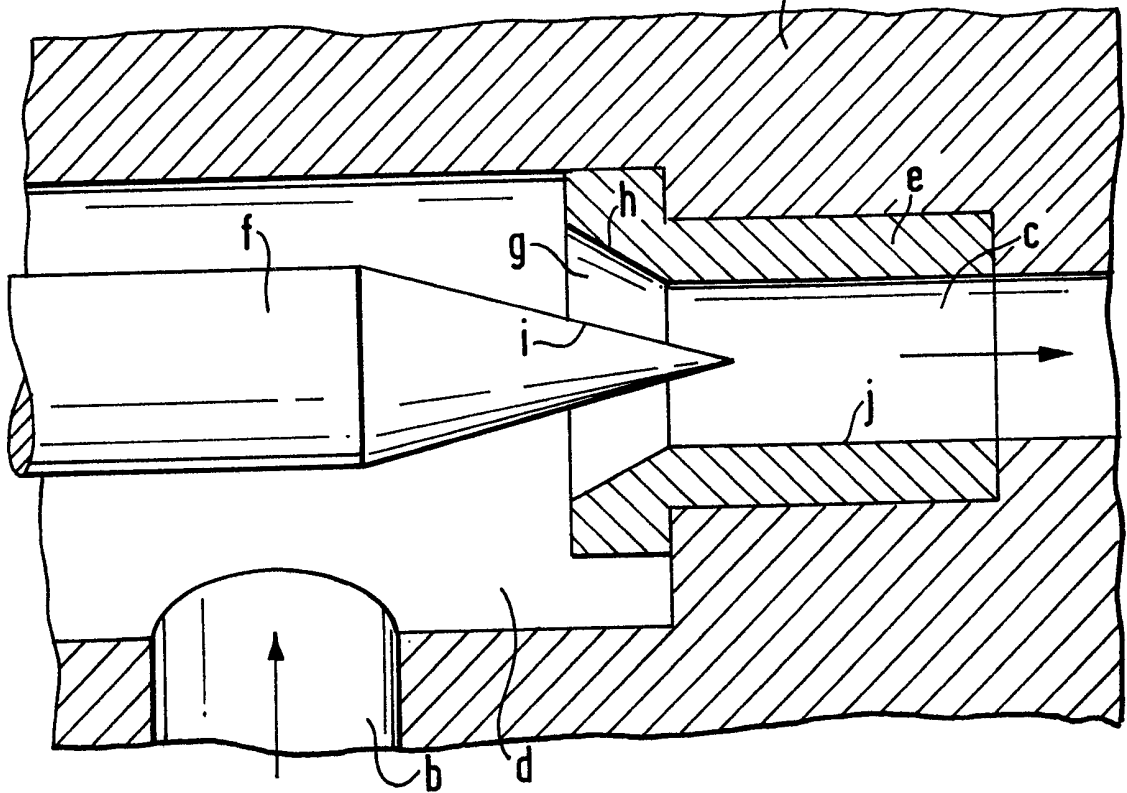


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PRIOR ART

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FIG.1A.



PRIOR ART

FIG.1B.

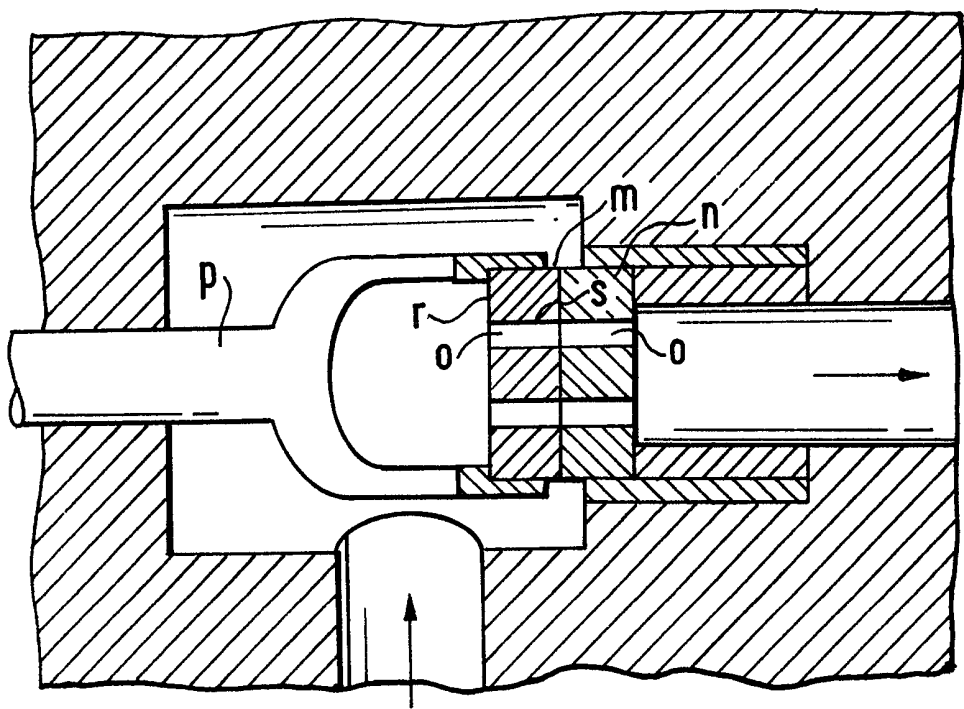


FIG.1C.

PRIOR ART

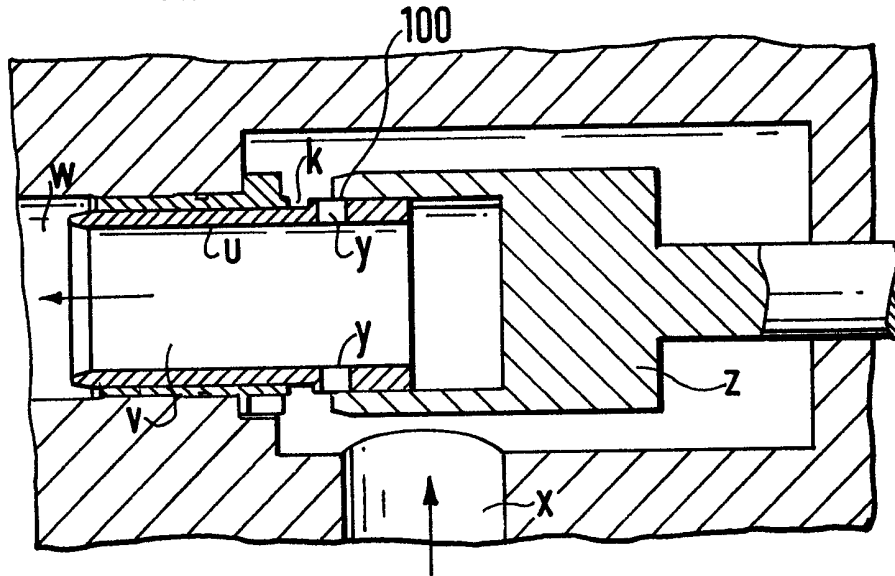
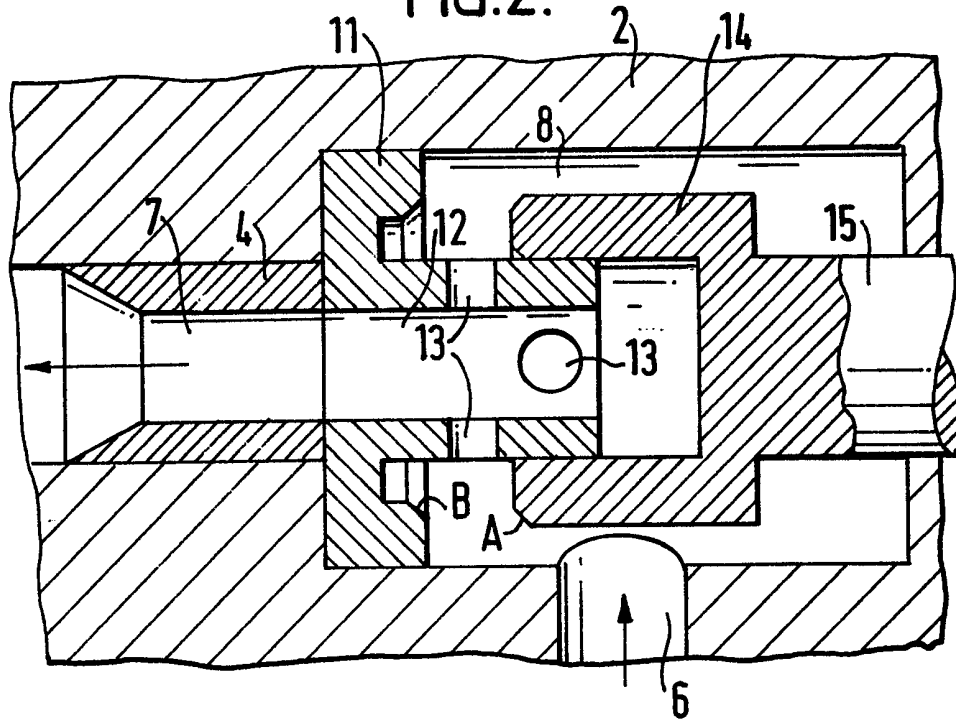
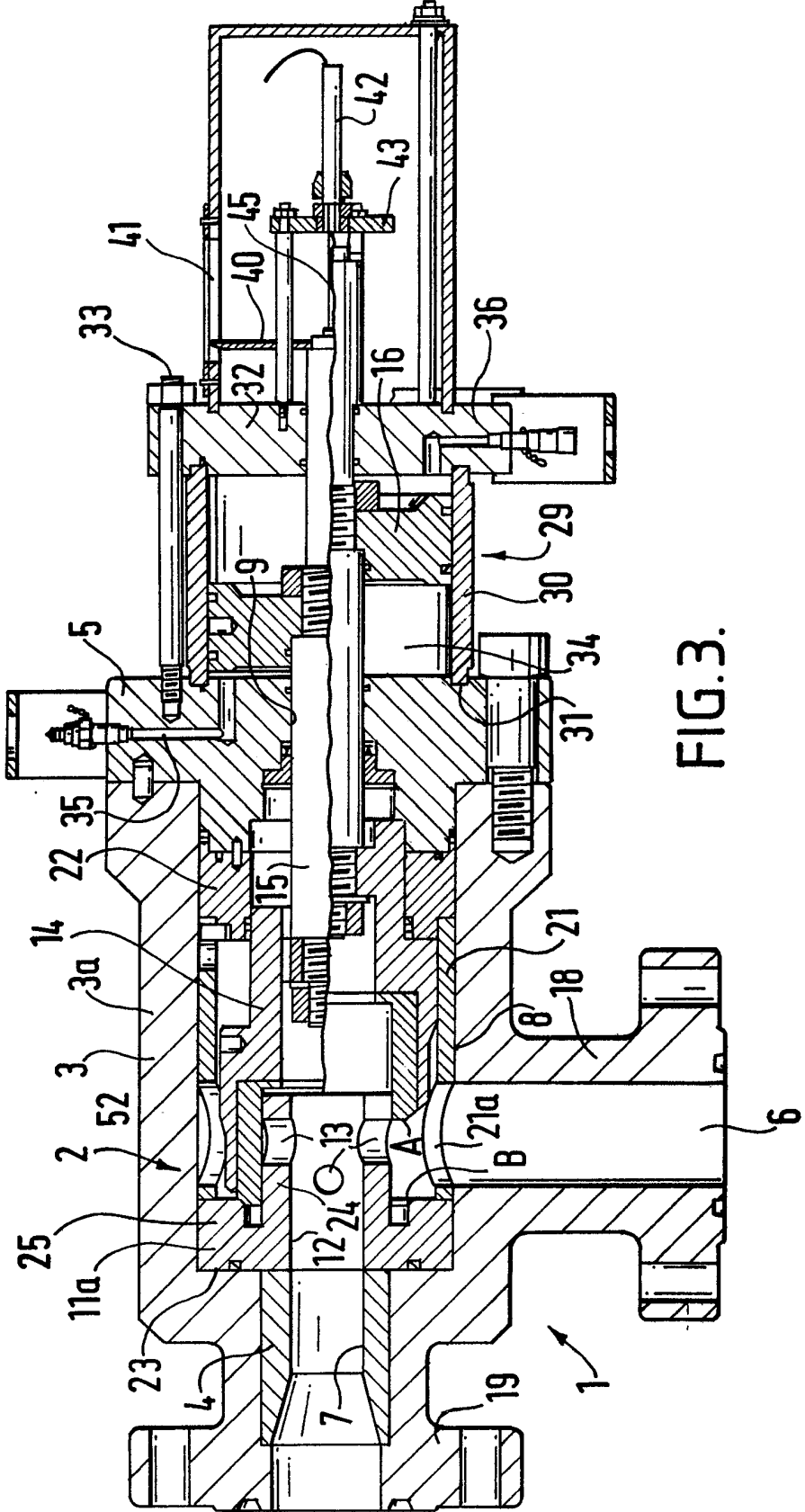


FIG.2.





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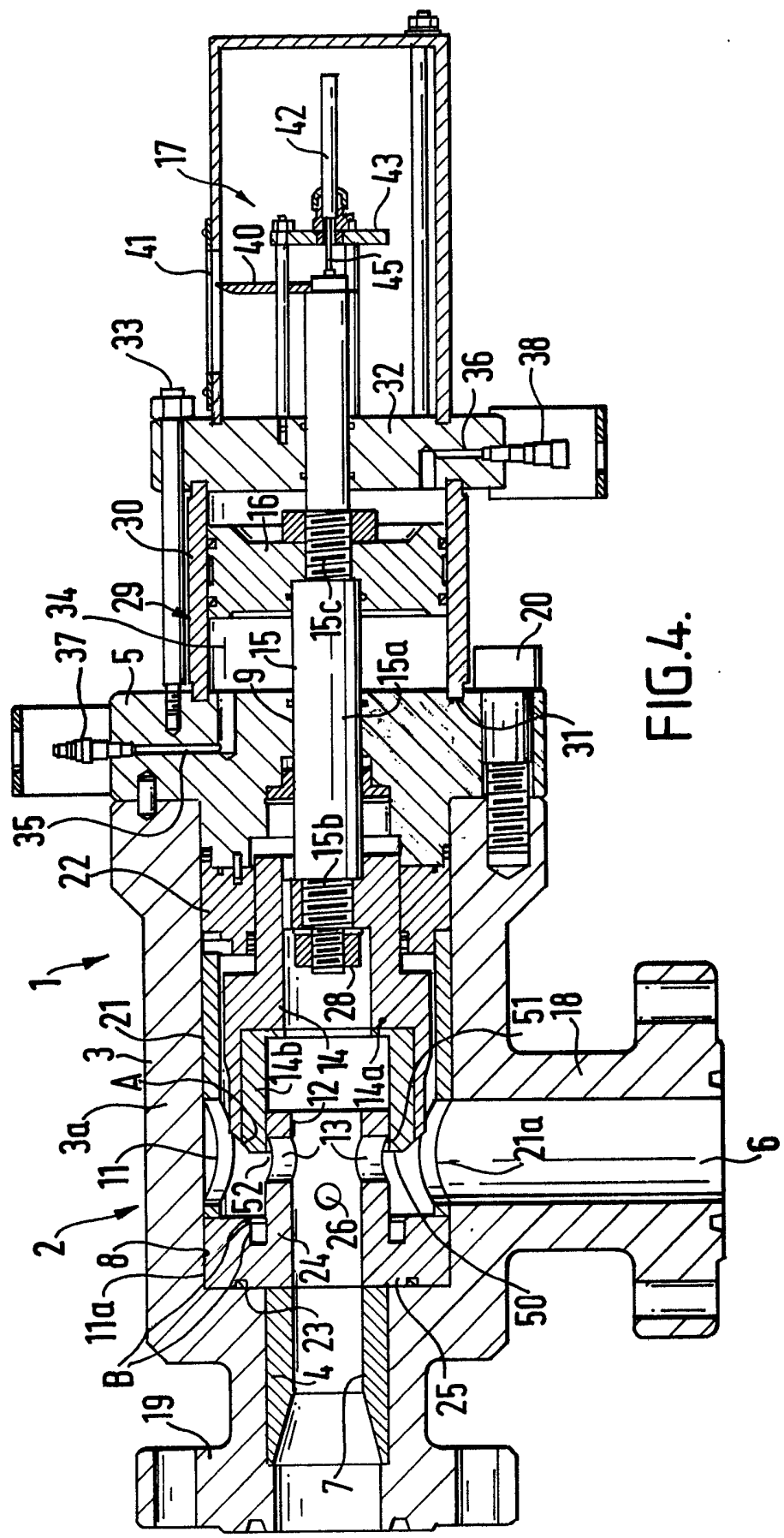


FIG. 4.

SPECIFICATION

Fluid flow choke

This invention relates to fluid flow chokes.

Chokes are devices commonly used in oilfields, for both drilling and production, to restrict or shut off pressurized flow through a flowline.

The fluid streams with which chokes are used are frequently laden with abrasive material, such as rock cuttings and sand. These streams can erode or wear through even the hardest steels. Over the years, therefore, there has been much thought and innovation applied to chokes, with a view of improving their durability.

Following below is a short discussion of three types of prior art chokes which are in commercial use today. Some of their strengths and weaknesses, which are of interest, are touched upon. They are discussed with reference to Figures 1A to 1C of the accompanying drawings, each of which shows diagrammatically in longitudinal section, a respective prior art choke.

The oldest of the three types may be referred to as a needle-and-seat choke. A simplified schematic representation of this type of prior art choke is shown in Figure 1A. The choke includes a hollow body assembly *a*, which body assembly defines inlet and outlet bores *b*, *c* joined by a main bore *d*. A tubular throttling member or ring *e* is positioned in the main bore *d* at the entry to the outlet bore *c*. A plug or needle member *f* is mounted on a valve stem, for movement into or out of the throttling ring *e*. Entry of the needle member *f* into the throttling ring *e* forms a restricted annular throttling passage *g*, defined by the throttling surfaces *h*, *i* of the throttling ring and needle member.

It will be noted that the throttling surface *h*, *i* are large in surface area, they are contiguous to the restricted or high velocity flow zone, and they are relied on to provide the final or complete shut-off. Because of their proximity to the high velocity flow, these throttling surfaces erode rapidly and soon lose their capability for providing an effective shut-off. Also, the annular fluid jet issuing from the annular passage *g* is found to have a particular capability for eroding the downstream surface *j* of the outlet bore *c*. Although abrasion-resistant steel collars are used to form the outlet bore *c*, wear at this point is still a problem with needle-and-seat chokes.

The second type of choke may be referred to as the rotating-disk choke. It is shown schematically in Figure 1B. This choke comprises two abutting discs *m*, *n*. The discs are mounted to extend across the main bore of the choke. Each disc defines a semi-circular opening or port *o*, which is spaced outwardly from the disc's centre point. The upstream disc *m* is connected with a stem *p*. This stem may be rotated to bring the port of the upstream disc *m* into partial or complete register with the port of the downstream disc *n*. When the ports are in register, they form a throttling passage.

By utilizing a throttling passage which is a port,

as distinct from an annular opening, the rotating-disk choke provides throttling surfaces which are reduced in area when compared with those of the needle-and-seat choke. The durability of the rotating-disk choke is significantly improved by this change.

However, significant erosion does occur at the disc surfaces *r*, *s* which are disposed transversely to the oncoming high velocity flow. This erosion soon leads to loss of complete shut-off capability. Also, the stream issuing from the partly registering ports is angularly directed. This angularity is induced by the misaligned positioning of the partly registering ports. The angularly directed flow causes damaging erosion of the bore surface downstream of the discs.

The third, and most recently developed, type of choke may be referred to as the advancing-cylinder choke. A recent form of this choke is illustrated schematically in Figure 1C. An older version is shown in United States Patent 4,132,386. With reference to Figure 1C, the choke comprises a generally tubular nozzle member *u*, which is slidably disposed in the main bore of the choke body assembly. The nozzle member bore *v* communicates with the outlet bore *w* of the choke. The nozzle member bore *v* is also connected with the choke inlet bore *x* by aligned ports *y*, which extend through the sidewall of the nozzle member and provides a throttling passage. A tubular throttling ring member *z* is also disposed in the main bore of the body assembly. This throttling ring member *z* may be advanced by a stem to slide over the nozzle member *u* and throttle the flow through the ports *y*. When the throttling ring member is approaching the end of its travel to the left, it contacts the nozzle member and biases it to the left. A deformable seal *k*, positioned between the end of the nozzle member and the body assembly, is thereby outwardly extruded and combines with the throttling ring to provide the liquid-tight shut-off or seal.

The advancing-cylinder choke is improved in that the aligned, opposed positioning of the throttling ports *y* results in the incoming streams impinging against one another; it is found that downstream wear is thereby significantly reduced. In addition, the utilization of throttling openings which are circular holes reduces wear of the throttling surfaces, as compared with that encountered with the needle-and-seat choke.

However, the advancing-cylinder choke has some undesirable features as well. Erosion of the leading corner 100 of the throttling ring member occurs, due to the proximity of this corner to the high velocity flow. When the surface of this eroded corner is required to co-operate with the deformable seal *k* to provide the liquid-tight shut-off, failure occurs. In addition, the need for a movable nozzle member requires that a retaining support means be provided, which is expensive.

With the foregoing comments in mind, there is therefore a need for an improved choke which adopts desirable features from the prior art and melds them with new additional features to

provide a simple and durable device.

The present invention aims to provide an improved choke.

According to a first aspect of the present invention, there is provided a choke having a sealed fluid flow path therethrough which is to be restricted or closed, comprising:

a hollow body assembly having an inlet bore and an outlet bore joined by a main bore;

a stationary member positioned in the main bore and defining a first bore which communicates with the outlet bore;

said stationary member forming a passage means which is adapted to connect the first bore with the inlet bore, whereby the bores and passage means provide the fluid flow path;

a movable throttling member, positioned within the main bore, for controlling flow through the passage means, said throttling member being movable relative to the stationary member from a first position, wherein the passage means is open, to a second position wherein the passage means is restricted or closed, said throttling member having a throttling surface which functions to restrict the flow;

means connected with the throttling member, for moving the latter between the first and second positions;

said throttling member having an annular first seal surface which is spaced upstream from the passage means;

said stationary member having an annular second seal surface, which is spaced upstream from the passage means, which is positioned to meet the first seal surface to close off the passage means from the body assembly inlet bore when the throttling member is in its second position, to provide a substantially liquid-tight seal.

According to another aspect of the present invention, there is provided a choke having a sealed fluid flow path therethrough which is to be restricted or closed, comprising:

a hollow body assembly having an inlet bore and an outlet bore joined by a main bore;

a stationary member, comprising a tubular nozzle member, positioned in the main bore and defining a first bore which communicates with the outlet bore, said nozzle member forming a passage means through its side wall, which passage means is adapted to connect the first bore with the inlet bore, whereby the bores and passage means provide the fluid flow path;

a movable tubular throttling member, positioned within the main bore, for controlling flow through the passage means, said throttling member being movable relative to the nozzle member from a first position, wherein the passage means is open, to a second position wherein the passage means is restricted or closed, said throttling member having a throttling surface which functions to restrict the flow;

means, connected with the throttling member, for moving the latter between the first and second positions;

said throttling member having an annular first

seal surface which is spaced upstream of the throttling surface and passage means;

said stationary member having a second seal surface, spaced upstream from the passage means, which is positioned to meet with the first seal surface to close off the passage means from the body assembly inlet bore when the throttling means is in its second position, to provide a substantially liquid-tight seal.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to Figures 2, 3 and 4 of the accompanying drawings, in which:

Figure 2 is a simplified longitudinal section showing the working components of primary interest of a preferred embodiment of the present invention;

Figure 3 is a more detailed longitudinal section of the preferred embodiment of the invention, in which the upper half of the figure shows choke parts in a fully closed position and the lower half shows them in a fully open position; and

Figure 4 is a similar view similar to Figure 3, but showing the choke parts in a partly open position.

Description of the Preferred Embodiment

In General

In Figures 2 to 4, there is shown a choke 1, comprising a hollow body assembly 2. The body assembly 2 comprises a body 3, a wear sleeve 4 and a bonnet 5. The assembly 2 defines or forms an inlet bore 6, an outlet bore 7, and a main bore 8 joining the inlet and outlet bores. The bonnet 5 defines a stem bore 9 which is axially aligned with and communicates with the main bore 8.

A stationary member 11, comprising a tubular nozzle member 11a, is positioned within the body main bore 8. The nozzle member 11a defines a first bore 12 which communicates with the outlet bore 7. It also comprises a throttling passage which communicates with the inlet bore 6; the throttling passage is created by ports 13 which extend through the side wall of the nozzle member 11a.

A movable, tubular throttling member 14 is disposed within the main bore 8. This throttling member 14 is mounted on a stem 15, which may be biased or moved toward or away from the nozzle member 11a by a hydraulically actuated piston 16. In the course of this movement, the throttling member 14 slides longitudinally over the nozzle member 11 and partially or fully closes the throttling ports 13. When the throttling member 14 has moved over the ports 13 and closed them, an annular seal surface A on the throttling member 14 mates with an annular seal surface B on the nozzle member 11, to effect a substantially liquid-tight shut-off.

Indicator means 17, connected with the stem 15, provide an indication of the position of the throttling member 14, and thus of the area of the throttling ports 13 which is open for flow. The flow rate through the choke is directly related to this area.

The Body Assembly

As previously stated, the body assembly 2 comprises a hollow body 3, a wear sleeve 4 and a bonnet 5.

- 5 The body 3 is generally T-shaped. It includes: a flanged inlet means 18, which defines or forms a vertically extending inlet bore 6; a flanged outlet means 19, comprising the replaceable wear sleeve 4, which defines a horizontally extending outlet bore 7; and a main body segment 3a, which defines the horizontally extending main bore 8.

The bonnet 5 closes off the open end of the main bore 8. It is secured to the main body segment 3a by bolts 20.

15 *The Stationary Member*

The stationary member 11 comprises a trio of annular components arranged in abutting relation to extend between the shoulder 23 of the outlet means 19 and the bonnet 5. More particularly, the member 11 comprises the nozzle member 11a, a spacer 21, and a retainer sleeve 22.

- 20 The nozzle member 11a comprises a tubular segment 24, spaced inwardly from the surface of the main bore 8, and a flange section 25, which has a close fit in said bore. A first bore 12 extends horizontally through the nozzle member 11. The tubular segment 24 defines throttling ports 13 which are adapted to connect the first bore 12 with the inlet bore 6, whereby the bores 6, 7, 8 and ports 13 may provide the fluid flow path through the choke.

The retainer sleeve 22 abuts the bonnet 5 and acts as a bearing for the stem 15. It also provides a sealing function, as described below.

- 35 The tubular spacer 21 fits snugly between the nozzle member flange section 25 and the retainer sleeve 22, with the result that these components are fixed between the bonnet 5 and the body shoulder 23. The spacer 21 also defines a port 21a, which permits fluid communication between the inlet bore 6 and main bore 8.

- 40 When the choke 1 is in use, pressurized fluid proceeds through the inlet bore 6, the spacer port 21a, the main bore 8, the throttling ports 13, the nozzle member bore 12, and exists through the outlet bore 7.

The Stem Assembly

- The stem assembly comprises a stem 15 and means for biasing the inner end of said stem back and forth within the main bore 8 of the choke.

- 50 The stem 15 comprises a cylinder portion 15a which extends inwardly into the body assembly 2 through the bore 9 of the bonnet 5. At its inner end 15b, the stem 15 is reduced in diameter and threaded. The throttling member 14 is screwed onto the stem inner end 15b and secured in place with a nut 28.

- A hydraulic cylinder 29 is provided to bias the stem 15 in and out. The cylinder 29 comprises an annular barrel 30, whose inner end is seated in an annular groove 31 formed in the bonnet 5. A cap 32 is fitted to the outer end of the barrel 30 and is secured to the bonnet 5 by bolts 33. The barrel 30

- and cap 32 combine to define a piston chamber 34. A piston 16 is threaded onto the reduced diameter, threaded outer end 15c of the stem 15. The piston 16 is thus positioned within the chamber 34. A hydraulic fluid passage 35 extends through the bonnet 5 and communicates with the chamber 34; a similar passage 36 extends through the cap 32 and communicates with said chamber 34. Hydraulic hose fittings 37, 38 are provided at the outer ends of the passages 35, 36.

- 70 Hydraulic fluid may be selectively pumped into the inner or outer ends of the piston chamber 34 through the passages 35, 36 to bias the piston 16 and the attached stem 15 either out or in.

- 75 The hydraulic cylinder and stem combine to provide means, connected with the throttling member 14, for moving the latter between a first position, wherein the throttling ports are open, and a second position, wherein they are restricted or closed.

The Throttling Member

- 85 The throttling member 14 is positioned within the spacer 21 and may slide over the nozzle member 11a, with which it has a snug fit.

- The throttling member 14 comprises a carrier 14a, which is threaded on the stem 15, and an insert 14b. The insert 14b is made of abrasion-resistant material and is tightly held by the carrier 14a.

- 90 The throttling member 14 may be biased to the left to partially and eventually completely close the throttling ports 13. Restriction of fluid flow through the ports 13 is effected by the leading corner 52 of the throttling member 14. This corner 52 is formed by throttling surfaces 50, 51.

Indicator Means

- 100 A pointer 40 is attached to the stem 15. This pointer 40 co-operates with a calibration plate 41 to provide a visual indication of the position of the stem 15, and thus of the extent of closure of the throttling port 13, which has been effected by the throttling member 14.

- 105 Alternatively, one may use a remote display system to indicate flow rate. Such a means is shown in the drawing and comprises a commonly used indicator potentiometer 42 attached to a mounting plate 43. A piston, internal of the potentiometer 42, is attached to the valve stem 15 by a rod 45 and is operative to move within the potentiometer 42 to vary its resistance. This change in resistance is sensed by suitable conventional means (not shown) and a signal may be emitted to actuate display means (not shown) at a remote location.

Sealing Means

- 110 An important feature is the provision of annular shut-off sealing surfaces which are remote from and upstream of the throttling ports 13 and restricted, high velocity streams passing through them.

- 115 In the embodiment shown, the throttling member 14 is provided with the annular seal

surface A.

The nozzle member 11a is also provided with its annular seal surface B, spaced away from and upstream of the throttling ports 13, 26. This surface B is positioned to mate with the surface A, when the throttling member 14 has closed the throttling port 13 to provide a liquid-tight shut-off seal.

O-ring seals are provided as shown in Figure 3 to provide liquid tight seals as needed to contain the hydraulic operating fluid and to prevent leakage of the fluid flow. The areas of these seals are balanced to minimize the hydraulic force needed to open and close the choke.

The foregoing is a description of just one embodiment of the invention. The scope of the invention is defined by the following claims.

CLAIMS

1. A choke having a sealed fluid flow path therethrough which is to be restricted or closed, comprising:
 a hollow body assembly having an inlet bore and an outlet bore joined by a main bore;
 a stationary member positioned in the main bore and defining a first bore which communicates with the outlet bore;
 said stationary member forming a passage means which is adapted to connect the first bore with the inlet bore, whereby the bores and passage means provide the fluid flow path;
 a movable throttling member, positioned within the main bore, for controlling flow through the passage means, said throttling member being movable relative to the stationary member from a first position, wherein the passage means is open, to a second position wherein the passage means is restricted or closed, said throttling member having a throttling surface which functions to restrict the flow;
 means connected with the throttling member, for moving the latter between the first and second positions;
 said throttling member having an annular first seal surface which is spaced upstream from the passage means;
 said stationary member having an annular

second seal surface, which is spaced upstream from the passage means, which is positioned to meet with the first seal surface to close off the passage means from the body assembly inlet bore when the throttling member is in its second position, to provide a substantially liquid-tight seal.

2. A choke having a sealed fluid flow path therethrough which is to be restricted or closed, comprising:
 a hollow body assembly having an inlet bore and an outlet bore joined by a main bore;
 a stationary member, comprising a tubular nozzle member, positioned in the main bore and defining a first bore which communicates with the outlet bore, said nozzle member forming a passage means through its side wall, which passage means is adapted to connect the first bore with the inlet bore, whereby the bores and passage means provide the fluid flow path;
 a movable tubular throttling member, positioned within the main bore, for controlling flow through the passage means, said throttling member being movable relative to the nozzle member from a first position, wherein the passage means is open, to a second position wherein the passage means is restricted or closed, said throttling member having a throttling surface which functions to restrict the flow;
 means, connected with the throttling member, for moving the latter between the first and second positions;
 said throttling member having an annular first seal surface which is spaced upstream of the throttling surface and passage means;
 said stationary member having a second seal surface, spaced upstream from the passage means, which is positioned to meet with the first seal surface to close off the passage means from the body assembly inlet bore when the throttling means is in its second position, to provide a substantially liquid-tight seal.

3. A choke substantially as hereinbefore described with reference to Figure 2 of the accompanying drawings.

4. A choke substantially as hereinbefore described with reference to Figures 3 and 4 of the accompanying drawings.