May 14, 1968 J. P. RIBB ET AL 3,382,930

BLAST JOINT

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Fig. 1

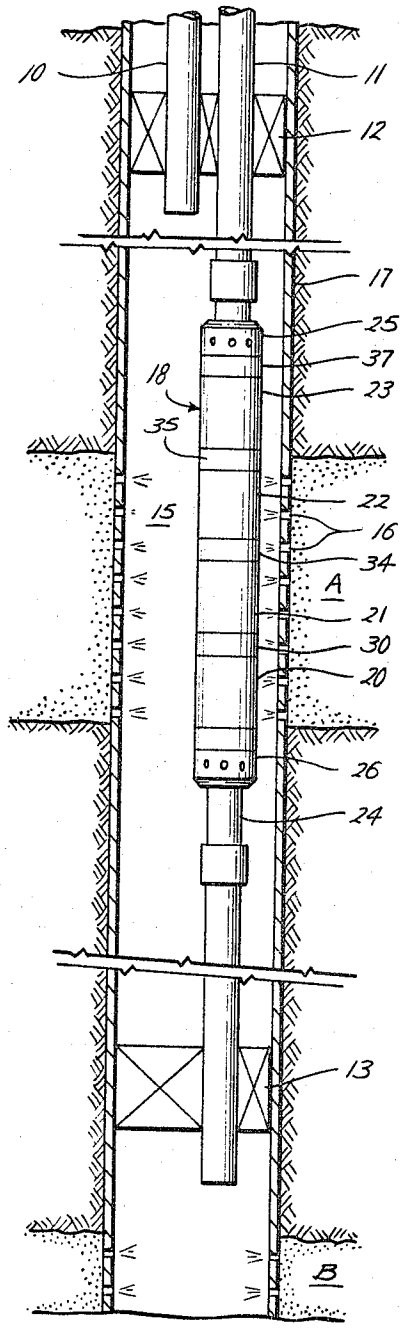
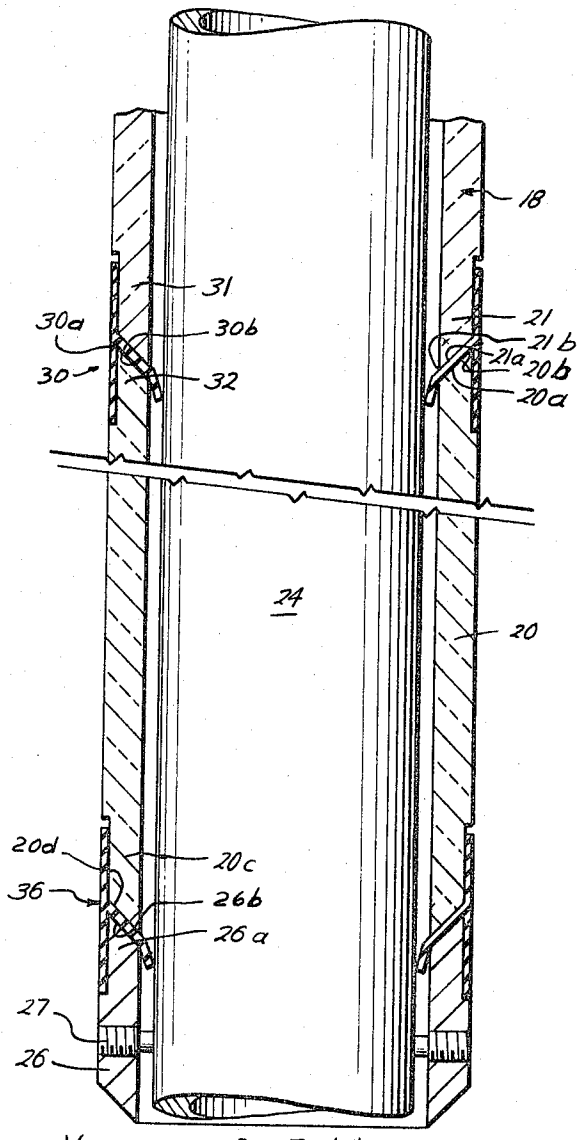


Fig. 2



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3,382,930

BLAST JOINT

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This invention relates to blast joints generally, and more particularly, to an improved blast joint of the type that employs ceramic material to resist the eroding action of the fluid flowing against the joint.

In wells having more than one producing zone, it is a common practice to provide a separate string of tubing for each zone and to keep the producing zones and the fluid they produce isolated from each other. With this arrangement, the tubing strings for the lower zones extend through at least one producing zone and are exposed to the eroding action of the fluid flowing into the well bore from this zone. This eroding action can be severe, particularly where the fluid is flowing into the well bore at a high velocity and contains entrained sand particles. To protect tubing strings subjected to these conditions, a specially constructed joint is installed in each string at a point opposite each producing zone through which it extends. These joints are called "blast joints."

Since certain ceramic materials are highly resistant to the eroding action of fluid, one commonly used blast joint is a section of well tubing incased in a sleeve of ceramic material. This ceramic sleeve usually consists of a plurality of short tubular members of ceramic that are slipped over the joint and held against longitudinal movement in end to end relationship. Usually, there is internal clearance between these members and the tubing, however, that allows some pivotal movement between the members. When this occurs, portions of the outer edges of the end surfaces of the members are moved laterally into a position where they tend to engage obstructions encountered on the way into the hole. For example, the outer edges of the members may hit the ends of the casing joints through which they are run due to the gap between the ends of such joints in the collars connecting them together. This subjects the tubular members to a substantial impact blow. Ceramic is used because it is hard, but it is also brittle, and such impact blows frequently cause the ceramic to chip and break, leaving a gap in the sleeve through which the eroding fluid can reach the tubing. Further, the facing end surfaces of these members usually are arranged to overlap to keep laterally flowing fluid from passing between their ends, this results in the outer edge of one and the inner edge of the other of the two facing end surfaces being relatively thin. The end surface with the thin outer edge is particularly susceptible to this type of damage. The end surfaces with thin inner edges are subject to damage also, as by being forced against the tubing or subjected to high bending stresses due to relative movement of the members.

It is an object of this invention to provide a ceramic blast joint of the type described which may be run into the well and positioned opposite a producing zone with the likelihood of damage occurring to the ceramic portion of the joint due to the ends of the ceramic member hitting obstructions in the well greatly reduced.

It is another object of this invention to provide an improved ceramic blast joint wherein the outer edge of the end surfaces of the ceramic members are not exposed to the obstructions in the well bore as the blast joint is moved therethrough.

It is another object of this invention to provide a ceramic blast joint which has a smooth outside surface of

uniform diameter that offers a minimum of surface irregularities to engage obstructions in the well bore.

It is another object of this invention to provide a joint between two adjacent tubular ceramic members mounted on a joint of tubing with their end surfaces in abutting relationship which protects the tubular ceramic members from chipping or other damage by reason of the outside edge of their end surfaces striking obstructions as the members are moved through a well bore.

It is another object of this invention to provide a ceramic blast joint made up of a plurality of tubular ceramic members slipped over a tubing string and held in end to end relationship with facing end surfaces in which each member is cushioned from the shock or impact load imposed on any other member making up the joint.

It is another object of this invention to provide a ceramic blast joint made up of a plurality of tubular ceramic members in which the members are resiliently held in spaced relationship to the tubing string they are protecting.

It is yet another object of this invention to provide a joint between two adjacent tubular ceramic members mounted on a tubing joint that tends to hold the members in axial alignment as they are run into the well.

It is another object of this invention to provide a protector for the tubular members of a ceramic blast joint that will hold the members in axial alignment in end to end relationship with their end surfaces facing while protecting the outer edges of the end surfaces from striking obstructions, cushion the members from impact blows received by other members, and hold the members away from the tubing string.

These and other objects, advantages and features of this invention will be apparent to those skilled in the art from a consideration of this specification and attached drawings.

The invention will now be described in connection with the preferred embodiment thereof as shown in the drawings wherein:

FIGURE 1 is a vertical sectional view through a portion of a well that is producing fluid from two separate producing zones with a blast joint constructed in accordance with this invention in the tubing string that extends through the upper zone; and

FIGURE 2 is an enlarged vertical sectional view of a portion of the blast joint of FIGURE 1.

In the well shown in FIGURE 1, upper producing zone A is flowing to the surface through tubing string **10** and lower producing zone B is producing to the surface through tubing string **11**. Packers **12** and **13** (shown schematically) are arranged to isolate the two producing zones in the conventional manner. Tubing string **11**, of course, must pass through producing zone A and, therefore, it is subjected to the eroding action of the fluid flowing from this zone into well bore **15**. The fluid flows into the well bore through perforations **16** in casing string **17**.

To protect tubing string **11** against the eroding action of this fluid, blast joint **18** is positioned in the string opposite the upper producing zone. The blast joint comprises a ceramic sleeve made up of a plurality of tubular ceramic members **20**, **21**, **22** and **23** that are slipped on tubing joint **24** in end to end relationship. The members, which are usually made of ceramic of the isostatic type, are held in position by stop members **25** and **26**. The stop members are annular collars of an impact resistant, non-brittle material, such as steel. They are provided with a plurality of set screws **27**, which engage tubing joint **24** and hold the stop members or collars and the ceramic members between them against longitudinal movement on the joint.

In the embodiment shown in the drawings the end

surfaces of the ceramic tubular members are conically shaped and arranged so the facing end surfaces of adjacent members will overlap. Thus, as shown in FIGURE 2, lower end surface **21***a* of tubular member **21** tapers downwardly and inwardly while facing end surface **20***a* of member **20** tapers upwardly and outwardly at the same angle and in the same direction as surface **21***a*. This shape is preferred for the ends of the members, as it tends to interlock the members and give stability to the assembly. With this arrangement however, outside edge **20***b* of end surface **20***a* of tubular member **20** is relatively thin and would be readily damaged should it encounter an obstruction. Inside edge **21***b* is also thin and therefore more subject to damage should it be moved against the tubing or subjected to a high bending stress.

In accordance with this invention, means are provided to keep the outer edges of either end surface **20***a* or **21***a* from hanging up on obstructions in the well bore as the blast joint is moved longitudinally therein. In the embodiment shown, protector **30** comprising annular ring **30***a* is arranged to encircle the two abutting end surfaces. Ring **30***a* should be made of a material that is ductile and capable of withstanding considerable impact without breaking. Thus, the ring may be made of steel, aluminum, copper or certain plastics that are impact resistant and which have sufficient strength and rigidity to hold the members in alignment and resist the wear of the casing at the temperature of the well. Preferably, however, the ring is made of rubber. Also preferably, the ring is relatively thin so as to leave as thick a section of ceramic material beneath it as possible. For if the ring is made of certain of the materials set out above, it may be eroded away rapidly by the fluid flowing against the blast joint. This is one of the advantages of using rubber for rubber has a high resistance to erosion and can remain intact on the joint for the length of time the blast joint stays in service in the well bore where the eroding conditions or length of time in service are not excessive.

To hold ring **30***a* in place encircling the outer edges of end surface **20***a* and **21***a*, portion **31** adjacent lower end surface **21***a* of tubular member **21** is of reduced diameter and portion **32** of member **20** adjacent the end surface **20***a* is of reduced diameter. These two portions combine to provide an annular groove into which annular ring **30** fits. Preferably, the ring is designed to fill up the groove as nearly as possible so that the outside surface of the blast joint is smooth and virtually uninterrupted to reduce the surface irregularities which might catch on the ends of casing joints, etc., and to hold the members in axial alignment. Thus, the thickness of the groove and its inside diameter should be such that it snugly fits around the members and its outside diameter such that it is substantially flush with the outside surface of the members. Its length, however, should be such that it will not hold the ends of the ceramic members apart. Therefore, there will usually be a slight gap between the end of the ring and at least one end of the groove, exposing said end of the groove. This creates no problem obviously if it is the lower end of the groove that is exposed, and if it is the upper end the ring is close enough to guide this end past any obstructions without damage.

Protector **30** is also provided with means for providing a cushion between the facing end surfaces of adjacent members and means for holding the members spaced from the tubing string. In the embodiment shown, annular body **30***b* is integrally attached to ring **30** between its ends. This annular body is generally of uniform thickness and tapered downwardly and inwardly, i.e., it is conically shaped. The body tapers downwardly at about the same angle as the facing end surfaces **20***a* and **21***a* of the tubular ceramic members so it can extend therebetween. Thus, by making body **30***b* of a resilient elastomeric material, such as rubber, it will provide a cushion between ceramic members **20** and **21** and reduce the effect on one of the members of an impact blow suffered by the other.

Further, annular body **30***b* being attached to ring **39***a* helps hold the ring in position around the ends of the ceramic members. This action of the body is particularly important if the ring is made of a relatively flexible material, like a low durometer rubber, which would tend to be washed out of the groove in which it is located as the blast joint is being moved through a column of liquid.

To further stabilize the ceramic members on the tubing string and to resiliently hold them against lateral movement, the opening through annular body **30***b* is equal to or less than the outside diameter of the section of the tubing string it encircles. If the body is made of rubber, preferably the opening therethrough is smaller in diameter than the tubing it encircles so it will be stretched as shown in FIGURE 2 when installed. This insures that the body make contact with the tubing completely around the tubing and that the body will have to be further stretched before lateral movement of the ceramic members relative to the tubing can occur.

In this same manner, protectors **34** and **35** are arranged to cover, protect and cushion the outer edges of the facing end surfaces of ceramic tubular members **21**, **22** and **23** and to hold them against lateral movement relative to the tubing. Also, stop collars **25** and **26** have their end surfaces conically shaped and their outer surfaces grooved so protectors **36** and **37** can be positioned to protect the end surfaces of the ceramic members they engage. Thus, as shown in FIGURE 2, stop member **26** has a portion **26***a* of reduced diameter that combines with portion **20***c* of member **20** to form a groove to receive protector **36** and its upper end surface **26***b* is tapered upwardly and inwardly at the same angle as end surface **20***d* of member **20**.

From the foregoing, it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the apparatus.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

The invention having been described, what is claimed is:

1. A ceramic blast joint to be installed in a tubing string opposite a producing zone in a well, comprising a joint of tubing, a plurality of tubular members of ceramic material of the isostatic type positioned on said joint in end to end relationship with their end surfaces facing to form a protective sleeve covering the outside surface of at least a portion of said joint, means for holding said sections in end to end relationship, and means for protecting the ceramic members from being chipped or broken by having the outer edges of their end surfaces hitting obstructions while the joint is being positioned in the well, said means being impact resistant and positioned to encircle the outer edges of each two facing end surfaces and a portion of each member adjacent said facing end surfaces, said encircled portions being of reduced diameter to form an annular groove to receive said means and hold it over the outer edges of the facing end surfaces.

2. The combination of claim **1** in which said protecting means includes a plurality of rings of impact resistant material, each ring being positioned in one of said grooves and having a thickness and an outside diameter such that it will tend to hold the members in axial alignment and its outside surface will be substantially flush with the outside surface of the members.

3. The combination of claim **1** further provided with means extending between the facing end surfaces for cushioning the members.

4. The combination of claim 3 in which said cushioning means comprises an annular body of elastomeric material having a central opening therethrough with a diameter less than the outside diameter of the joint of tubing.

5. The combination of claim 1 in which said protecting means comprises a plurality of rings of elastomeric material, each ring being positioned in one of said grooves to protect the outer edges of the facing end surfaces it encircles, each of said rings being further provided with an inwardly extending annular body of elastomeric material positioned between the facing end surfaces the ring encircles, said annular body having an opening therethrough through which the joint of tubing extends that is smaller than the outside diameter of the joint where the joint is engaged by the body.

6. The combination of claim 5 in which the facing end surfaces on the ceramic members are conical and taper inwardly from the outside edge thereof in the same direction and generally at the same angle, and in which the annular body located between the facing end surfaces is of uniform thickness generally and conically shaped, tapering at the same angle and the same direction as the facing end surfaces.

7. A blast joint for installation in a tubing string that extends through a fluid producing zone of a well to resist the eroding action of the fluid entering the well bore therefrom, comprising, a sleeve of isostatic ceramic material for encasing a portion of the tubing string opposite said producing zone, said sleeve including a plurality of tubular ceramic members positioned on the string in end to end relationship with their end surfaces facing, two stop members for positioning on the string with the ceramic members therebetween and with each stop member having one of its end surfaces facing the end surface of the adjacent ceramic member to hold the ceramic members against longitudinal movement on the string, and means for protecting the ceramic members from damage and for centering the sleeve on the pipe string comprising a plurality of annular bodies of resilient, elastomeric, material, one of said bodies being located between each two facing end surfaces, each annular body having a central opening smaller in diameter than said tubing string.

8. The combination of claim 7 further provided with means for protecting the ceramic members from damage due to the outer edges of their end surfaces striking obstructions as the sleeve is run into the well bore and for holding the members in axial alignment comprising, a plurality of rings of impact resistant material, each positioned to encircle the abutting end surfaces of the members, said members being of reduced diameter adjacent each end surface to combine with the adjacent members to form annular grooves to receive said rings, each ring having an outside diameter, a thickness and a length to substantially fill the groove in which it is located to combine with the members to form a sleeve having a substantially uninterrupted, smooth outside surface.

9. A joint between two tubular ceramic members on a blast joint comprising a ring of elastomeric, resilient, impact resistant material encircling the facing end surfaces of the members, said members being of reduced diameter adjacent their facing end surfaces to form a groove in which the ring is located, said ring having an outside diameter substantially equal to that of the members and a thickness and length substantially equal to the depth and length of the groove so that the ring is flush with the outside surfaces of the members and will hold the members in axial alignment, said ring being further provided with an inwardly extending, integrally attached annular body of resilient elastomeric material located between the facing end surfaces to cushion the ceramic members.

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