Feb. 18. 1941. S. E. DIESCHER 2,232,593

WELDED CASING JOINT

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Fig. 1.

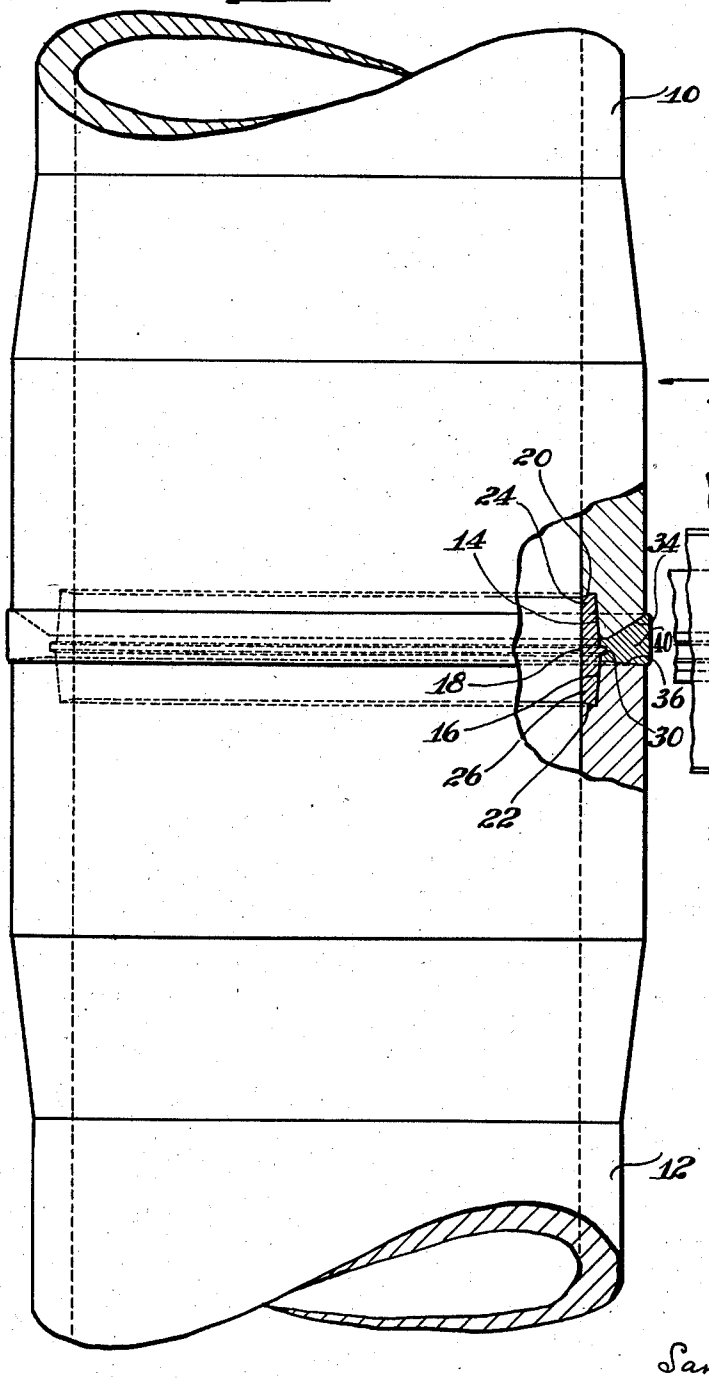


Fig. 2.

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WELDED CASING JOINT

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1 Claim. (Cl. 285—111)

This invention relates to welded joints for tubular members and more particularly is concerned with welded joints for oil well casing and the like.

Heretofore, it has been the standard practice to line drilled well holes, and particularly deep holes as made in drilling for oil, with pipe or casing which has been connected end to end, usually by threaded joints. Sometimes the joints are made by threading each end of the casing with a male thread and then employing a female coupling sleeve. Again, the ends of the casing have been formed with complementary male and female joints. Threaded joints, regardless of the type, are relatively expensive to manufacture and, although they can be conveniently made up or taken apart in the field, they are by their inherent nature of substantially greater overall diameter than the body of the casing proper so that in order to finish the well with a desired casing size it is necessary to start drilling and casing the well with a considerably larger size to allow the various strings of casing forming the complete casing program to be nested or positioned one inside the other. The larger the starting hole size is, the greater is the cost of drilling the well with a particular finishing hole size, since a greater amount of earth has to be removed and a greater tonnage of casing must be employed. Moreover, such threaded casing joints have usually had a low efficiency (joint efficiency equals strength of joint divided by strength of the casing proper) so that when subjected to high tensional stresses, as for example when the casing is being set into a very deep well or is being pulled out of a well, the joints were apt to fail. Further, when casings are subjected to high fluid pressure and heavy tension, as occurs in deep wells, threaded joints have been found to leak.

It has been proposed heretofore to reduce the cost of casing an oil well and to avoid leakage at the joints by welding the lengths of casing together end to end and thereby eliminate the threading operation. One manner of welding casing end to end which has been employed is to form one end of each casing length with a bell which is adapted to receive the plain spigot end on the other end of another length of casing. The end of the bell is then welded to the side wall at the end of the spigot to provide what might be termed a fillet lap weld joint between the casing lengths. This procedure saves the cost of threading, but the overall diameter of the joint is not materially reduced so that the advantage of having the smallest possible starting hole size for a given finishing hole size is not obtained. Moreover, it has been proposed to butt weld casing lengths end to end, but so far as I am aware, this has not met with entire success due, among other causes, to the difficulty of making entirely good butt welds with the casing lengths end to end and in a vertical position.

Likewise, I have found that both the butt and bell and spigot types of welds are usually open to the objection that the joint efficiency is low, and the internal bore of the welded casing is either not continuous and smooth or, in the case of butt-welded casing, is actually clogged or interrupted with inwardly extending welding metal. Such welding metal or other change in diameter of the bore of the casing in the region of the joint prevents the use of swabs, packings or the like in casing or materially reduces the life and effectiveness thereof, if they are employed. Further, I have found that the ordinary skilled welder finds great difficulty in satisfactorily welding oil well casing together end to end by known methods and using known types of joints.

It is the general object of my invention to avoid and overcome the foregoing and other difficulties of and objections to known joints for oil well casing in particular, and tubular members in general, by the provision of an improved welded joint which can be rapidly and inexpensively made by the ordinary welder with his usual equipment to provide a joint having high efficiency, a smooth internal bore and a minimum outside diameter.

Another object of my invention is to provide a welded joint for oil well casing or the like and wherein the joint is adapted to resist, without failure, tensional and collapsing stresses of an amount which cause failure of the casing body proper.

Another, and more specific, object of my invention is the provision of a welded joint for oil well casing or the like in which the aligning and spacing of the joint parts is facilitated by means of a tapered wedge ring which serves also to prevent any introduction of welding metal into the continuous bore of the joint.

Another object of my invention is to provide a welded joint for oil well casing or the like in which the cross sectional area of the weld is substantially greater than the cross sectional area of the casing body proper whereby the joint efficiency is at least approximately 100 per cent or more while maintaining the external diameter of the joint at a minimum.

The foregoing and other objects of my inven-

tion are achieved by the provision of a welded joint including a pair of tubular members having upset ends of like internal diameters, and an aligning ring having a bore of the same internal diameter as the diameter of the tubular members. The aligning ring is received in counterbores in the ends of the tubular members and interlocking means on the ring and the counterbores hold the ends of the ring against movement inwardly of the bore. Completing the combination are means welding the ends of the tubular members together and to the aligning ring. Usually the aligning ring is formed of a double wedge shape and the counterbores are tapered to a contour complementary to the aligning ring. The aligning ring also preferably includes a circumferential rib which extends between the ends of the tubular members and which melts during the welding operation, after aiding in centralizing the welding arc, to reduce the flow of heat to the radially inner surface of the aligning ring. The adjacent ends of the tubular members to be welded are each formed with a complementary bevel which together define a welding groove and usually the bevel on the end of the lower tubular member is sufficiently close to radial that it supports the fluid weld metal within the angle of repose when the tubular members are welded in a vertical position. Preferably the ends of the tubular members are upset externally prior to machining and assembling the ends for welding so as to provide a welding area approximately 25 per cent greater than the cross sectional area of the casing proper.

For a better understanding of my invention reference should be held to the accompanying drawing which illustrates one embodiment thereof and wherein Fig. 1 is a side elevation of a welded joint embodying the principles of my invention with portions thereof being broken away to illustrate the joint in cross section; and Fig. 2 is an enlarged vertical cross sectional view of a portion of the welded joint shown in Fig. 1.

While my improved welded joint may be used in conjunction with tubular members of various kinds and employed for many purposes, nevertheless my invention is particularly concerned with the provision of an improved welded joint for oil well casing and the like and accordingly has been specifically illustrated in conjunction therewith and will be so described.

In Figs. 1 and 2 of the drawing the numerals 10 and 12 indicate, respectively, the lower end of an upper casing length and the upper end of a lower casing length which ends are adapted to be welded together, usually while in a vertical position. Preferably, the ends of the casing lengths 10 and 12 are externally upset over a short distance, as for example approximately 5 inches in a casing having approximately a 6-inch internal diameter. The upset portions of the casing lengths are merged gradually into the portions of the casing which are not upset so as to avoid stress concentrations. The upsetting of the ends of the casing lengths is done to increase the radial thickness of the casing ends so that the cross sectional area of the weld is substantially greater than the cross sectional area of the casing body proper, all as hereinafter more fully discussed.

Each end of the casing lengths 10 and 12 is formed with inwardly tapered counterbores 14 and 16 which receive an aligning and spacing ring, indicated as a whole by the numeral 18 and formed with an internal diameter or bore of the same dimension as the internal diameter or bore of the casing upsets. Thus, the internal diameter of the casing lengths and the joint is constant and provides a smooth uninterrupted surface which permits the free use of swab packings and the like in the inside of the casing which is qute advantageous. The outer surface of the aligning and spacing ring 18 is formed as a double frustum of a cone so that it engages in complementary relation with the tapered surfaces of the counterbores 14 and 16, and thus acts to align the casing ends with each other and hold them in accurately positioned and spaced relationship which is highly advantageous when the casing is of the seamless tube type possessing wall eccentricity. I preferably machine the counterbores 14 and 16 while holding each casing centered on its bore rather than centered on its outside surface.

An important feature of my invention is the provision of interlocking means between the aligning ring 18 and the counterbores 14 and 16, which means prevent the radially inward movement of the ends of the aligning ring 18 during the welding of the joint or at any time thereafter. These means may obviously take a plurality of forms but conveniently comprise overhanging shoulders 20 and 22 at the ends of the counterbores 14 and 16 which engage in locking relation with chamfers or beveled surfaces 24 and 26 on the ends of the aligning ring 18. The interlocking action provided between the chamfered ends of the aligning ring 18 and the overhanging shoulders at the inner ends of the counterbores 14 and 16 serve to perform the desired function when the two casing lengths are forced onto the aligning ring merely by the weight of the upper lengths of casing to be joined.

I preferably form the aligning ring 18 with a circumferentially continuous, outwardly extending rib 30 which extends into the space between the ends of the casing lengths. I have found that the size and position of the rib 30 should be substantially that clearly illustrated in Fig. 2 in order to provide the best type of welding action. During the welding of the joint the rib 30 attracts the welding arc in the course of applying the first bead and thus not only centralizes the initial deposit of welding material as the rib melts down, but also insures the positive welding of the ring 18 to the welding metal and the ends of the casing lengths. Further, the melting down of the rib reduces the temperature of the aligning ring and particularly the radially inner surface thereof so that undesirable oxidation of the ring is eliminated. The radial thickness of the ring, approximately twenty-five per cent of that of the upset portion of the casings, keeps the temperature at the radially inner surface thereof at a point sufficiently low that undesirable oxidation of the ring surface is avoided. I have found that when the ring is proportioned to perform in the manner just stated it has ample size and area to take the stabbing pressure of the upper casing length without failure.

The extreme ends of each of the casing lengths 10 and 12 are formed with a bevel or chamfer as at 34 and 36 which are complementary to each other and together define the welding groove. It will be noted that the bevel or chamfer 36 on the lower casing end is relatively flat in that it is substantially radial. Usually this bevel is approximately 5° from the radial so that fluid weld metal positioned thereon is carried within the angle of repose and will not roll or slide off the

bevel. This is advantageous for the reason that the ordinary welder can perform a satisfactory job without the constant annoyance of working so that the weld metal will not flow out of the welding groove. The beveled surface 34 forms an angle of approximately 35° with the radial, although obviously it can be greater or less so long as sufficient surface and clearance are provided to permit the insertion and operation of a welding rod. It will be seen that the extreme ends of the casing lengths 10 and 12 stop short of engaging with the circumferential rib 30 on the aligning ring 18. Thus, when welding metal 40 is placed in the welding groove the welding metal flows down and around the circumferential rib 30 until the rib material has become molten.

It is believed that the construction of my improved joint for tubular members, and particularly oil well casing, will be understood from the foregoing detailed description. However, briefly outlining the method of making my improved joint, the lower casing length 12, positioned in the drilled hole or in a special hole in the derrick floor and upset and machined to the contour shown, first receives the aligning ring 18 which is merely fitted down into the tapered counterbore 16 in the end of the casing. Thereafter, the casing length 10 is raised by the draw works and elevator or by other suitable means and the lower end thereof is moved down to bring the counterbore 14 over the end of the aligning ring 18 after which the elevator or other lifting means is paid off to cause the full weight of the casing length to force the two lengths of casing and the aligning ring into accurately aligned and spaced relation with each other. This action also causes the interlocking means at the ends of the aligning ring and the counterbores to engage to hold the ends of the aligning ring against radially inward movement.

With the parts of the joint aligned and spaced as just described, the welder or a plurality of them places one or more tack welds around the welding groove to secure the ends of the casing together and to the aligning ring. The shrinking of the tack welding metal assists in interlocking the ends of the aligning ring 18 in the counterbores 14 and 16 so that any tendency for the aligning ring 18 to distort under the welding heat is not translated into radially inward movement of the ends of the aligning ring. Once the tack welds are made a first bead of welding material is laid completely around the bottom of the welding groove. After the first bead of welding material has its slag coating removed, a second, and usually a third, bead of welding material is laid around the welding groove and the welded joint is finished.

From the foregoing it will be recognized that the objects of my invention have been achieved by the provision of an improved welded joint particularly adapted for use in conjunction with oil well casing and the like. By making the ends of the casing upset externally I am able to increase the cross sectional area of the welded portion of the joint by an amount approximately twenty-five per cent greater than the cross sectional area of the casing body proper and thus make certain that the joint efficiency is at least one hundred per cent. This increase in the cross sectional area of the welded portion of the joint takes care of any inclusions or blow holes in the weld which often occur, and, moreover, allows for the unequal cooling stresses normally present in the weld. These stresses, which are known to be present in the weld, tend to reduce the joint efficiency but I have compensated for them by increasing the cross sectional area of the joint, as already explained.

My improved welded joint has a smooth internal bore of the same diameter as the bore of the casing body proper, and therefore the joint is particularly adapted to permit effective use of swab packings and the like in the bore of the casing, which is highly advantageous. Casings that are inherently smooth inside and regular in bore will have with this joint no interior irregularities destructive of swab packings and may even make possible the pumping of wells with swab-like equipment adapted to that purpose.

The outside diameter of the joint has been kept at the minimum required to provide the desired joint efficiency and therefore casing costs are likewise kept at the smallest possible figure. Furthermore, the characteristics of my improved joint permit the ordinary welder to rapidly and efficiently provide the desired joint with a minimum of equipment and time and without any possibility that the welding metal will in any way interrupt or extend into the bore of the joint. The upset ends of the casing in the region of the joint increase the resistance to collapse of the joint to such an extent that the body of the casing will fail prior to failure at the joint, and in the same manner the joint is adapted to resist torsional bending or tensile stresses in a better manner than the casing body proper.

While my improved welded joint is particularly adapted to use with oil well casing and the like, many of the advantages thereof are retained in welding together tubular members used in other relations, and I likewise contemplate welding my improved joint with the axes of the tubular members in other than a vertical position. Therefore, while I have in accordance with the patent statutes particularly illustrated and described one embodiment of my invention, it will be understood that I am not to be limited thereto or thereby but that my invention is defined in the appended claim.

I claim:

A welded joint comprising a pair of tubular members of a like internal diameter, and an aligning ring having a bore of the same internal diameter as the diameter of the tubular members, said aligning ring being received in counterbores in the ends of the tubular members and being provided with beveled ends interlockingly engaging overhanging shoulders at the inner ends of the counterbores for holding the ends of the ring against movement inwardly of the bore under welding heat, the ends of the tubular members being adapted to be welded together and to the aligning ring.

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