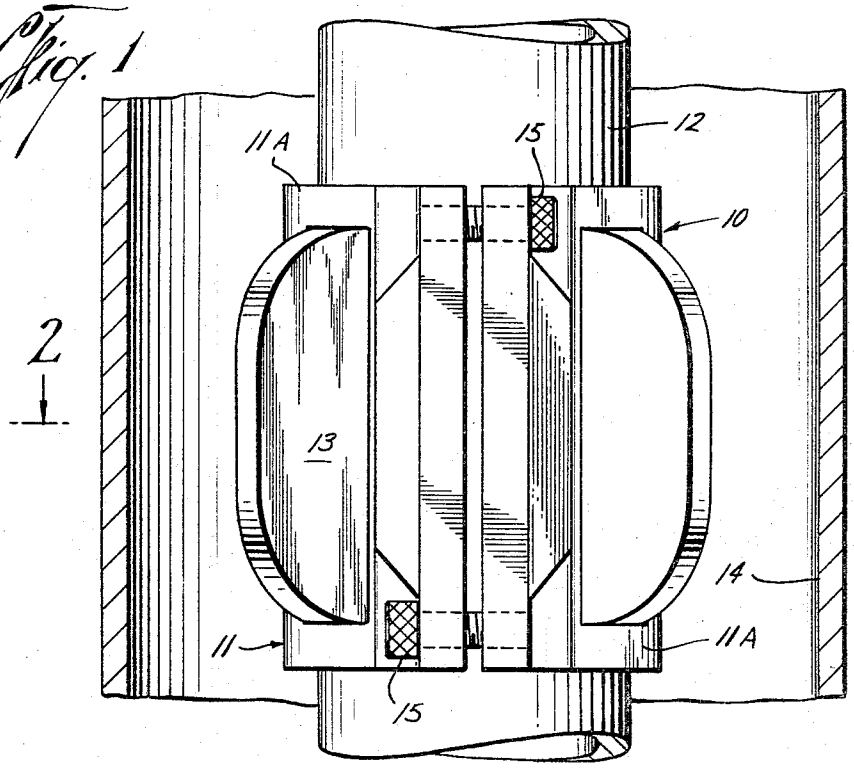
Dec. 20, 1966 L. C. MUNDT 3,292,708

TUBING CENTRALIZER

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Fig. 1



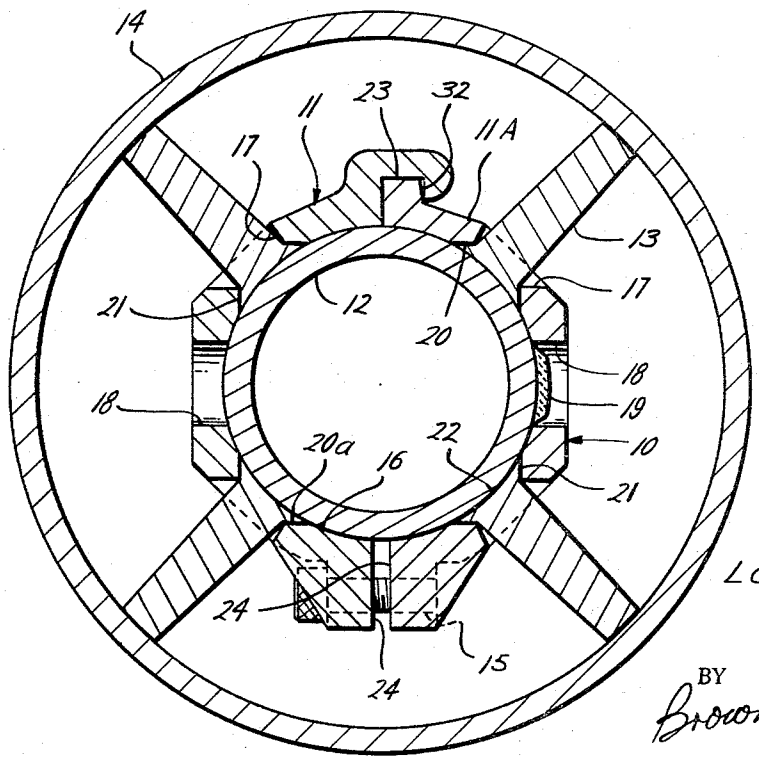


Fig. 2

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TUBING CENTRALIZER

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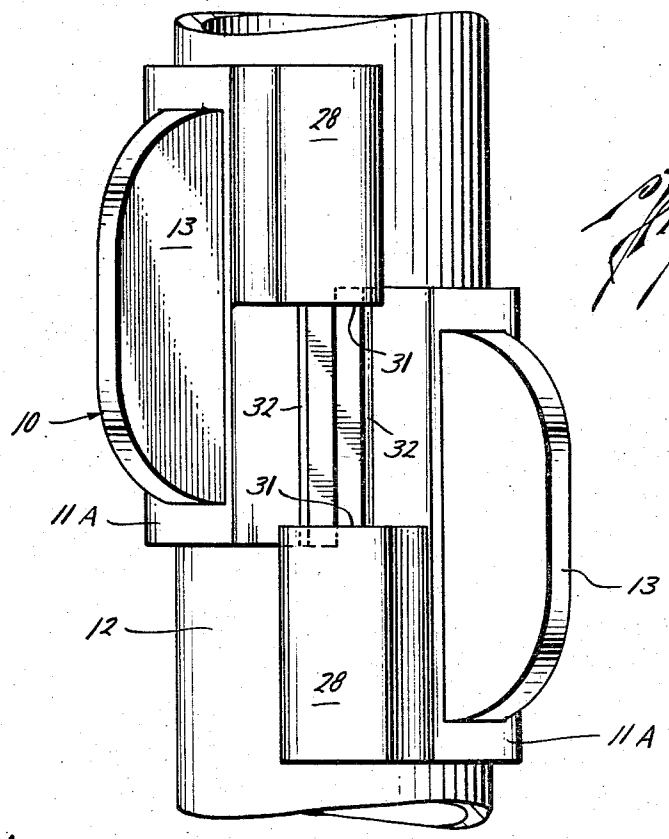


Fig. 3

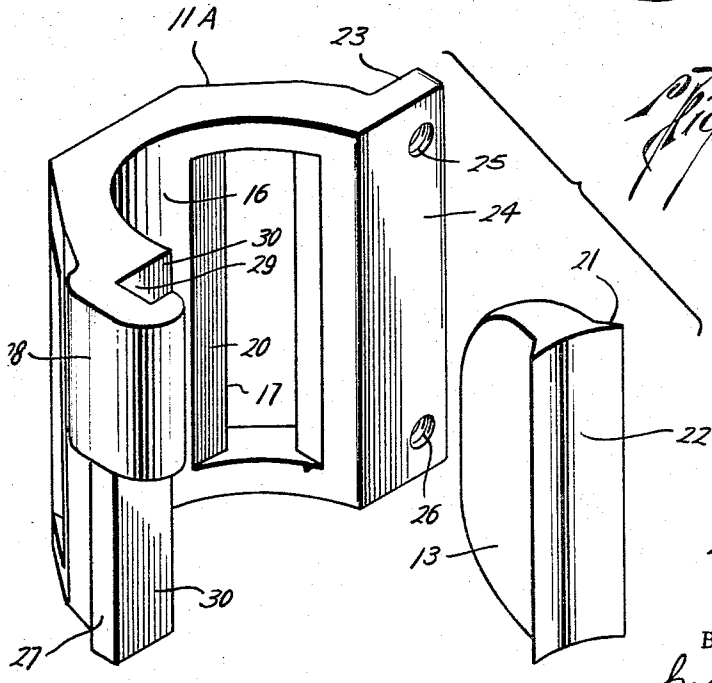


Fig. 4

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3,292,708

TUBING CENTRALIZER

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11 Claims. (Cl. 166—241)

This invention relates to a device, known as a "tubing centralizer," for use in holding a well tubing in spaced relation within a well casing. In a common device of this type, a multi-piece clamp is connected about the tubing and carries a plurality of wings for extension outwardly therefrom into engagement with the casing. More particularly, this invention relates to improvements in a centralizer of the type in which the wings are removably carried by the clamp to permit them to be replaced by other wings for use in casings of different sizes.

One distinct advantage of centralizers of this latter type is that the owner or user of same need stock only a single clamp for most any size of casing in which the tubing is to be centered. However, in prior centralizers, the connections between the opposite side edges of the clamp sections have been difficult to make, even when the wings form integral parts of the clamp portions. The necessity for holding the clamp sections about the tubing as these connections are made is especially awkward when care must also be taken to keep the removable wings in place. Also, in many such centralizers, there is no way for taking up slack between the clamp and tubing, as, for example, when the tubing is undersized, and the removable wings are therefore not held tightly about the tubing. Still further, in conventional centralizers of this type, the clamp portions or sections are of different construction so that each must be made from a separate casting and one of each must be stocked in order to make up a complete clamp.

Although a tubing centralizer has many uses, one environment in which it is particularly useful is in the location of tubing within a well casing prior to the packing of the annulus between them with gravel, because, in such an operation, it is extremely important that the tubing be kept in as central a position as possible. In a well which is completed in this manner, it is also frequently necessary or at least desirable to pull the tubing. Since the tubing is held against vertical movement with respect to the centralizer and the wings of the centralizer are packed in the gravel, it is often impossible to free the tubing. Thus, it has been proposed to form the centralizer of an aluminum alloy which will be disintegrated by caustic soda circulated through the annulus between the tubing and casing, thereby, freeing the tubing for pulling from within the casing.

On the other hand, if the centralizer is constructed of such material, there may be undesirable electrolysis between the tubing and casing as aluminum alloy is known to be highly electrolytic. Although it has also been proposed to form the wings at least partially of rubber so as to insulate the tubing from the casing, these have not proven to be entirely satisfactory. For one thing, they may be damaged during movement into and out of the casing, and even when not damaged, they are not sufficiently rigid to hold the tubing centered under all conditions. Furthermore, rubber is known to deteriorate in the presence of many chemicals found in or introduced into oil and gas wells. Still further, the lack of rigidity of rubber would make wings formed of it difficult to hold in place within the clamp portions of the centralizer, at least without a rigid backing plate of some type which would increase its cost.

An object of this invention is to provide a centralizer having clamp portions which are extremely simple to connect about the tubing, even though the wings thereof are

removable and thus loosely held by the clamp portions until such connection is made.

Another object is to provide a centralizer of the type above described in which the clamp portions may be of identical construction.

A further object is to provide such a centralizer which comprises a minimum number of parts and which is capable of taking up for slack between the clamp portions and the tubing so as to insure that the wings are held tightly thereabout.

Still another object is to provide a centralizer which permits the tubing to be freed therefrom upon the introduction of caustic soda into the tubing-casing annulus and having inexpensively manufactured replaceable wings of a construction which will not only insulate the tubing from the casing, but will also resist damage and deterioration during installation and use.

In the drawings, wherein like reference characters are used throughout to designate like parts:

FIG. 1 is a side elevational view of a centralizer constructed in accordance with the present invention and connected about a tubing for centering it within a casing;

FIG. 2 is a cross-sectional view of the centralizer of FIG. 1, as seen along broken line 2—2 of FIG. 1;

FIG. 3 is a side elevational view of the centralizer of FIGS. 1 and 2, as seen from the opposite side thereof, and during connection of the clamp portions about the tubing; and

FIG. 4 is an exploded perspective view of one of the clamp portions and a wing adapted to be removably received through an opening in such clamp portion.

With reference now to the details of the above-described drawings, and particularly FIGS. 1 and 2, thereof, the tubing centralizer, which is designated in its entirety by reference character **10**, comprises a clamp **11** connected about the tubing **12** and elongate wings **13** carried by the clamp and extending outwardly therefrom into engagement with the casing **14**. Thus, with the wings of equal radial extent, as shown, the centralizer **10** holds the tubing **12** coaxially of the casing **14** for the purposes previously described. It should be understood, however, that there may be instances in which it is desired to hold the tubing in an eccentric position with respect to the casing, in which case, of course, the wings **13** would be of unequal lengths. Although the tubing would not, in this latter case, be "centered" within the casing, the device would nevertheless be a "centralizer" of the type contemplated by this invention.

The clamp **11** is made up of a pair of identical clamp portions **11A** which are longitudinally interfitted along one side edge, in a manner to be described hereinafter, and then drawn together along the opposite side edges, so as to securely hold the wings **13** in outwardly extending relation from the clamp. Thus, as previously described, the wings **13** are removably carried by the clamp **11** so that they may be replaced, if desired, with wings of different radial extent for locating the tubing **12** within a casing **14** of a different size. Although not shown, it will be understood that such wings would correspond to those shown except insofar as their radial extent is concerned, whereby the user of the centralizer need only stock a single clamp for use with different sets of wings.

As best shown in FIGS. 2 and 4, each clamp portion **11A** comprises a substantially semi-circular casting having an arcuate inner face **16** adapted to conform to substantially one-half of the circumference of the tubing. Thus, when the two clamp portions are connected about the tubing, their side edges are disposed adjacent one another so as to at least substantially surround the tubing.

There are three openings in each clamp portion, the outer openings **17** being adapted to receive the wings **13**

therethrough and the inner opening **18** being disposable over and about a weldment **19** or other protuberance on the side of the tubing **12** so as to locate such clamp portion against longitudinal as well as rotational movement with respect to the tubing.

The outer openings **17** are spaced approximately 90° from one another about the arcuate inner face of each clamp portion, so that when the clamp portions are connected about the tubing, the wings **13** are at least substantially equally spaced thereabout. More particularly, the openings **17** are elongate to closely receive and provide bearings for the ends of the wings. The holes **18** are, on the other hand, preferably round so as to permit them to be fitted easily over a spot weld or other round protuberance.

Each clamp portion has shoulders **20** formed thereon on opposite sides of each of the openings **17**, and there are shoulders **21** toward the inner end of each of the wings **13** for engagement with the clamp portion shoulders when the clamp portions are connected about the tubing. More particularly, these shoulders are tapered convergently outwardly with respect to the tubing **12** so as to provide a firm bearing for the wings. In a preferred form of the invention, the inner end **22** of each wing is curved on substantially the same radius as the inner faces **16** of the clamp portions **11A** so that the clamp and wings will have full bearing about substantially the entire circumference of the tubing. That is, as the bolts **15** are made up to draw adjacent side edges of the clamp portions together, and the shoulders **21** on the wings are forced against corresponding shoulders **20** on the clamp portions, the curved inner ends **22** of the wings will form a substantial continuation of the arcuate inner faces **16** of such clamp portions.

One side of each clamp portion has a tongue **27** extending outwardly from one end thereof and a flange **28** providing an inwardly facing groove **29** on the opposite end thereof. More particularly, the tongue and groove extend in directions laterally adjacent one another, with the tongue **27** on the inner side of the edge or face **30** of the side of the clamp portion and the groove **29** on the outer side thereof. Upon reversal of the clamp portions end-for-end so as to dispose the flange **28** of the clamp portion at its upper end and the flange **28** of the other clamp portion at its lower end, the two clamp portions may be longitudinally interfitted with one another.

Thus, as shown in FIG. 3, the groove **29** in the flange **28** of one clamp portion may be moved longitudinally over the tongue **27** of the other clamp portion, while its tongue **27** is moved longitudinally into the groove **29** in the flange of such other clamp portion. More particularly, the inner end of each flange **28** provides a laterally extending abutment **31** for engagement with the corresponding surface **31** on the other clamp portion when the tongues and grooves of such clamp portions have been fully interfitted with one another. When the clamp portions are so interfitted about the tubing, in the manner shown in FIG. 3 and as will be described to follow, they are held by the flanges and grooves against lateral separation and one is supported longitudinally upon the other.

A flange **23** on the other side of each clamp portion **11A** has a pair of holes **25** and **26** therethrough, the first of these being drilled through to receive the inner end of a bolt **15** adjacent the head thereof and the other hole being threaded to receive the threaded outer end of a bolt. When the clamp portions are longitudinally interfitted, as above described, the edge or face **24** on each is disposed adjacent the corresponding edge of the other clamp portion so as to align the hole **25** on one flange with the hole **26** on the other. Thus, as shown in FIG. 1, the bolts may be extended through the holes **25** for threaded connection with the holes **26** and then made up to draw the side edges **24** together and thereby bring the inner ends **22** of the wings into bearing engagement with the tubing **12**, which in turn forces their shoulders **21** into tight engagement with shoulders **20** about the opening for the wing.

More particularly, the through hole **25** is provided in the same end of each clamp portion as the flange **28** and the threaded hole **26** in the same end thereof as the tongue **27**. Thus, the head of one bolt **15** abuts the flange **23** of one clamp portion for making up with the hole **26** in the other clamp portion, and the head of the other bolt abuts the flange **23** of such other clamp portion for make up with the hole **26** in said one clamp portion. Also, the flanges **28** of both clamp portions **11A** are of the same length so that, in accordance with the preferred embodiment of the invention, each such portion is identical. This not only simplifies their casting, but also facilitates their handling and stocking.

In the assembly of the centralizer, and with particular reference to FIG. 3, the opening **18** in the right-hand clamp portion is fitted over the protuberance **19** on one side of the tubing, and the inner face **16** of the clamp portion and the inner ends **22** of the wings **13** carried thereby are held against the tubing by one hand of the operator. The other clamp portion as well as the wings **13** loosely carried thereby is moved by the other hand of the operator into engagement with the opposite half of the tubing **12** above the first-mentioned clamp portion. The last-mentioned clamp portion is then moved longitudinally downwardly over the tubing so as to fit the groove **29** thereof over the flange **27** of the lower clamp portion and fit the flange **27** of such upper clamp portion into the groove **29** in the lower clamp portion. This longitudinal interfitting of the two clamp portions is continued until surface **31** on the upper clamp portion engages with the surface **31** on the other clamp portion so as to support it therefrom.

One side **32** of each flange **23** is tapered, as best shown in FIG. 2, so as to permit a certain amount of hinging or pivotal movement between the two clamp portions as they are longitudinally interfitted with one another. That is, this taper **32** facilitates a slight amount of spreading between the opposite side edges **24** of the clamp portions. This is particularly useful in installing the clamp portions about the tubing since it permits the one being moved relative to the other to be held fairly loosely about its portion of the side of the tubing, thereby insuring that it will slide freely along the tubing despite the fact that the wings are carried loosely from it.

The interfitting flanges and grooves will hold the clamp portions against lateral separation, as previously described, and the fitting of the protuberance **17** within the opening **18** of the right clamp portion will support such clamp portion longitudinally. Thus, the left-hand clamp portion is longitudinally supported due to engagement of its surface **31** with the corresponding surface **31** on the right-hand clamp portion. This frees both hands of the operator for grasping the bolts **15** and passing them through holes **25** and into threaded engagement with the holes **26**. As previously described, upon making up of the bolts, the clamp is connected about the tubing with the wings **13** securely held in outwardly extending relation therefrom for engagement with the casing **14** as the tubing with the centralizer disposed about it is lowered into the casing. Preferably, the upper and lower corners of the wings **13** are rounded so as to facilitate this insertion of the centralizer into the casing.

As previously described, when it is desired to pull the tubing from within the casing, and this is prevented by the disposal of the wings **13** of the centralizer within a gravel pack or like obstruction in the tubing-casing annulus, the operator may elect to disintegrate a portion of the centralizer so that the tubing may be freed from it. For this purpose, it is contemplated that the clamp portions may be cast of an aluminum alloy which will disintegrate

in a caustic soda which is circulated through the tubing-casing annulus. Obviously, upon disintegration of the clamp portions, the tubing will be free for upward longitudinal movement since it is the disposal of hole **18** about the tubing protuberance **19** which anchors the tubing to the centralizer.

On the other hand, in order to reduce the possibility of electrolysis between the tubing and casing, the wings **13** may be made of a material which will insulate between the tubing and casing. It is known that aluminum alloy is not a good dielectric and, since the wings **13** of this centralizer are in any case separate from the clamp portions thereof, this invention contemplates that they may be formed of a material which will not only provide the desired insulating qualities, but will also be as satisfactory from other standpoints as would wings of aluminum alloy or rubber. For example, other metals such as brass and steel are known to be poorer conductors than aluminum alloy. Also, resinous plastics are particularly good insulators and many of them are sufficiently hard to prevent their being damaged as the centralizer is lowered into the casing **14**. Still further, such plastics are sufficiently rigid that they will maintain the desired radial spacing between the tubing and casing, despite severe strains which may be encountered during the lowering and upon setting of the tubing. Also, this type of material is not as liable to deteriorate as rubber or rubber-like materials which have heretofore been used as wings in centralizers of this general type.

It is still further contemplated that wings **13** of this relatively rigid plastic material may be molded as one piece with the shoulders **21** for bearing upon the shoulders about the clamp portion openings formed integrally with the remainder of the wing. This will provide a solid bearing for the wing and at the same time permit it to be manufactured as inexpensively as possible.

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 tubing centralizer, comprising a pair of clamp portions adapted to be disposed about opposite sides of the tubing, each clamp portion having openings therein, a wing receivable through each said opening for extension outwardly from the clamp portion, shoulder means on each wing and the clamp portion engageable with one another to so locate the wing within said opening when the clamp portions are disposed about the tubing, means forming a part of said clamp portions longitudinally interfitting and supporting one clamp portion from the other clamp portion, merely upon said other clamp portion being held against its side of the tubing and said one clamp portion being moved longitudinally along the other side of the tubing toward said other clamp portion, and means for urging the inner ends of the wings against the tubing so as to hold the shoulder means thereon in engagement with the shoulder means on the clamp portion.

2. A tubing centralizer of the character described in claim **1** wherein the clamp portions are identical.

3. A tubing centralizer, comprising a pair of clamp portions each having openings therein and an inner face adapted to be disposed about substantially one half of the tubing, a wing receivable through each said opening for extension outwardly from said clamp portion for engagement with the casing, shoulder means on each wing engageable with shoulder means on the clamp portion about the opening through which said wing is received, means forming a part of said clamp portions for longitudinally interfitting a side edge of one clamp portion with a side edge of the other clamp portion and supporting said one clamp portion from said other clamp portion, merely upon the other clamp portion being held about its half of the tubing, and said one clamp portion being moved longitudinally along its half of the tubing and toward said other clamp portion, and means for drawing the opposite side edges of the clamp portions together, when said clamp portions are so interfitted and said one clamp portion is supported from the other, so as to urge the inner ends of the wings against the tubing and thus the shoulder means on each wing into engagement with the shoulder means about the opening in which said wing is received.

4. A tubing centralizer of the character described in claim **3**, wherein the inner end of each wing and the inner face of each clamp portion are curved to substantially the radius of the tubing, and said inner end of each wing forms a substantial continuation of the curved inner face of the clamp portion when the shoulder means on said wing is engaged with the shoulder means on said clamp.

5. A tubing centralizer of the character described in claim **3**, wherein said last-mentioned means comprises bolts received through the side edge of one clamp portion for threaded connection with a side edge of the other clamp portion.

6. A tubing centralizer of the character described in claim **5** wherein each clamp portion is identical.

7. A tubing centralizer, comprising a pair of clamp portions each having openings therein and an inner face adapted to be disposed about substantially one half of the tubing, a wing receivable through each said opening for extension outwardly from said clamp portion, shoulder means on each wing engageable with shoulder means about the opening in the clamp portion through which said wing is received, means on a side edge of one clamp portion for longitudinally interfitting with a side edge of the other clamp portion, as said other clamp portion is held against its half of the tubing, and said one clamp portion is moved longitudinally along its half of the tubing and toward said other clamp portion, connecting means on the other side edges of the other clamp portions for drawing them together when disposed adjacent one another and thereby urging the inner ends of the wings against the tubing so as to cause the shoulder means thereon to engage with the shoulder means on said clamp portions, and means on the longitudinally interfitting means of each of said clamp portions engageable with one another to support one clamp portion from said other clamp portion with said other side edges adjacent one another, whereby they may be drawn together by said connecting means.

8. A tubing centralizer of the character described in claim **7**, wherein said longitudinally interfitting means comprises a tongue on one end of the side edge of each clamp portion and means providing a groove on the other end thereof for interfitting with the tongue of said other clamp portion.

9. A tubing centralizer, comprising a pair of substantially semi-cylindrical clamp portions each having an arcuate inner face adapted to conform to substantially one half of the circumference of the tubing and an edge along each side adapted for disposal adjacent a corresponding edge of the other clamp portion when both such portions are conformed about the tubing, means providing openings in each clamp portion having inwardly facing shoulders on opposite sides thereof, a wing removably received through each opening for extension outwardly therefrom and having shoulders on opposite sides thereof for engagement with the shoulders on said clamp portion, the inner ends of the wings being curved to sub-

stantially the same radius as the inner faces of the clamp portions so as to form a substantial continuation of said inner faces when said shoulders are engaged, a tongue extending outwardly from one end of a side edge of each clamp portion and a flange having an inwardly facing groove on the other end of said side edge of the clamp portion, the groove in the flange of each clamp portion extending in a direction laterally adjacent said tongue so as to receive the tongue of said other clamp portion as said clamp portions are moved longitudinally of one another, the end of the flange of each clamp portion providing a laterally extending surface for abutment with the laterally extending surface of the other clamp portion as said portions are so moved longitudinally of one another, another flange on the opposite side of each clamp portion for disposal opposite the other flange on said other clamp portion, and holes in said other flanges alignable with one another upon abutment of the laterally extending surfaces on said first-mentioned flanges for receiving bolts for drawing said other flanges together and thereby urging the inner ends of the wings against the tubing so as to hold the shoulders thereon against the shoulders about said openings.

10. A tubing centralizer of the character described in claim **9**, wherein the tongue and groove on each clamp portion are of equal longitudinal extent so as to dispose the abutment surface midway of the ends of the clamp portion, and there are a pair of holes in the other flange of each clamp portion, the hole on one end thereof being drilled through and the hole on the other end thereof being threaded.

11. A tubing centralizer, comprising a clamp comprising separate portions for disposal about the tubing and having openings therein, a plurality of wings each removably receivable through an opening in a clamp portion for extension outwardly therefrom, said clamp portions being made of aluminum alloy which will disintegrate in the presence of caustic soda, and each of said wings being made of a rigid resinous plastic material which will not so disintegrate, which is a better electrical insulator than the first-mentioned material of which the clamp portions are made, and which has shoulders formed integrally thereon for engagement with shoulders about the clamp portion opening in which it is received, and means for connecting the clamp portions about the tubing to urge said shoulders into engagement with one another and thereby hold the wings in outwardly extending relation from the clamp portions.

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