

[54] **FRYING PAN WITH A WELDED
HOLLOW-CORE EXPANSION JOINT**

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219/421, 219/521, 220/67, 338/316**

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220/67, 75, 76**

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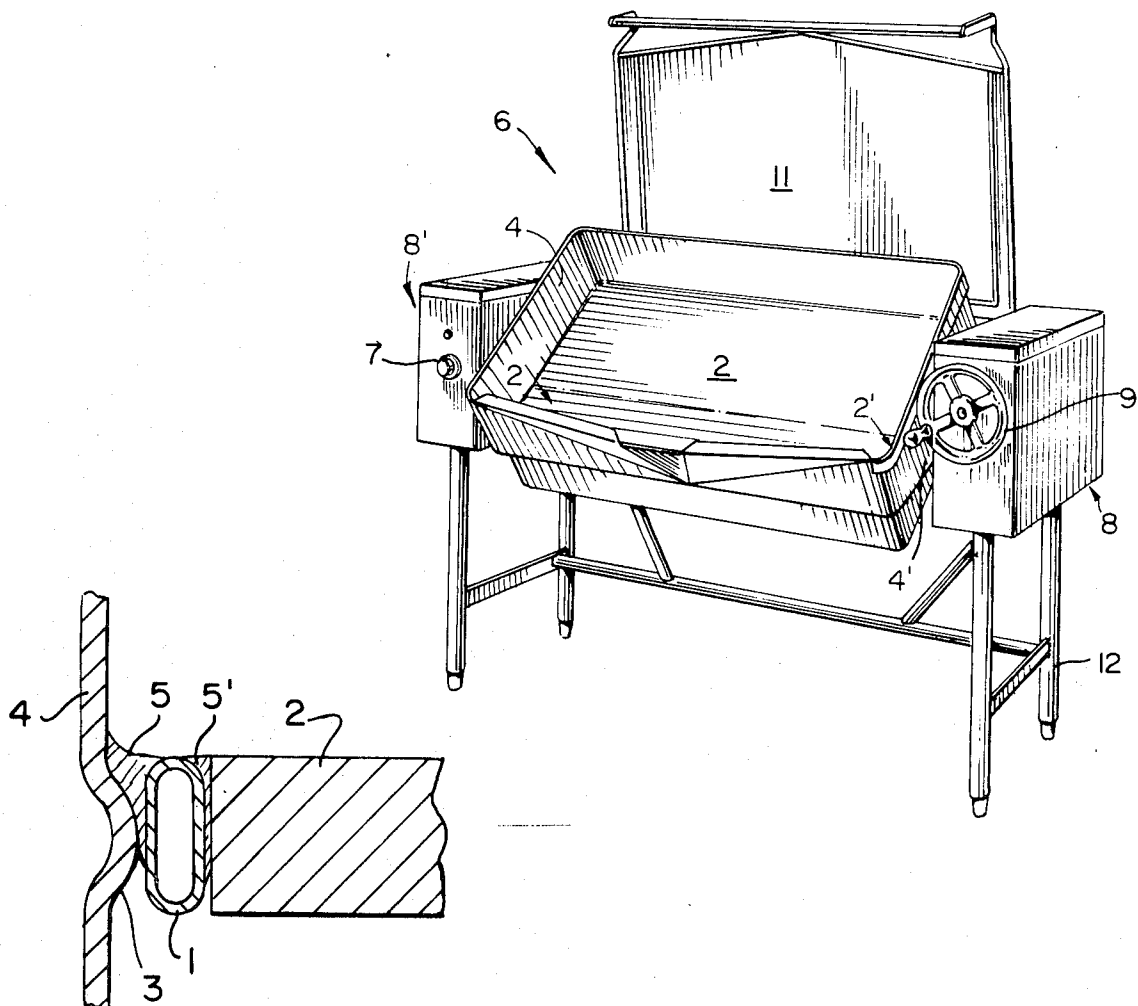
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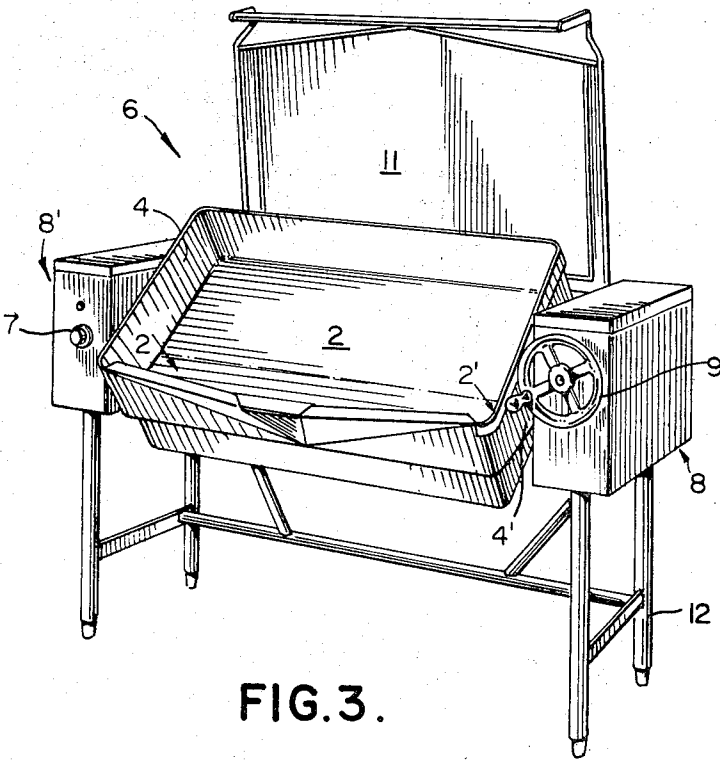
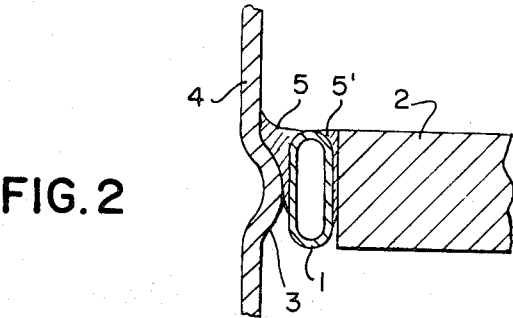
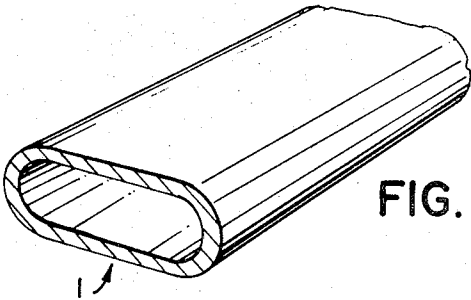
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[57] **ABSTRACT**

A commercial type heating or cooking utensil having a hollow-core expansion joint in the weld seam between the dissimilar metals. The weld seam between the dissimilar metals has a tendency to crack or break due to the continued heating and cooling cycle of the utensil when in operation. A hollow-core expansion joint capable of being welded to each of the metals is laminated between the stainless steel and cast iron of the utensil and when bonded thereto, serves to absorb the stresses induced when the utensil is heated and cooled alternately. Hence, the novel of construction provides an improved stainless steel-cast iron cooking utensil capable of withstanding the induced stresses of the heating and cooling cycles accompanying operation, without cracking or breaking at the weld seam.

8 Claims, 3 Drawing Figures





FRYING PAN WITH A WELDED HOLLOW-CORE EXPANSION JOINT

BACKGROUND OF THE INVENTION

This invention relates to an improved method for welding stainless steel to cast iron and the welded article obtained therefrom. More particularly, the invention pertains to improvements in the construction of commercial type heating or cooking utensils which undergo continued heating and cooling cycles when in operation. The induced stresses arising in the weld seam between the dissimilar metals are of such magnitude as to cause failure of the weld and base metals by cracking or breaking thus rendering the cooking vessel unusable.

DESCRIPTION OF THE PRIOR ART

Ferrous alloys comprising substantially chromium, iron and nickel are referred to in the trade as stainless steels. The chromium-nickel stainless steels are those containing nickel and chromium plus other elements to a lesser degree. These chromium-nickel stainless steels are known as the austenitic chromium-nickel stainless steels. The nickel being added in sufficient amount to make the steels austenitic and nonmagnetic with improved ductility and conductiveness over the straight chromium steels.

More particularly austenitic stainless steels generally contain from about 16-22 percent chromium and at least 8 percent nickel and for this reason are commonly called 18-8 stainless steels. They are also known as the 300 series in the SAE rating code (see Table II below).

Cast iron is a high carbon (up to 25 percent) ferritic alloy, porous and very brittle due to the carbon content but of extreme toughness and resistance to impact stress.

The successful welding of stainless steel to a cast iron base metal has long been a difficult task due to the tendency of crack and fault formation in the welding-heat affected zone of the dissimilar metals, the low carbide solubility in the stainless steel layer, the porosity of the cast iron and the general metallurgical dissimilarities of a high carbon alloy and a stainless steel. The welds thus formed, in torch or arc-welding, are brittle, greatly lacking in ductility, exhibit a poor resistance to shock or impact, and are unable to endure much bending, shear or other stress.

The prior art has sought to overcome these unsatisfactory conditions in a vast variety of ways, these including inter alia, the altering of the base composition of the stainless steel alloys, increasing the carbide solubility in the austenitic or martensitic regions of the iron phase diagram by additive, introducing various hydrocarbon gases or reducing gases, e.g., hydrogen sulfide, during the welding process, etc. These several variants however, although improving the quality of the welds did not afford a weld capable of withstanding the severe stresses brought about by the continuous heating and cooling cycles experienced in commercial heating or cooking utensils. Moreover, the occurrence of such weld defects as described above is greatly increased during the fabrication of welded cooking utensils having a basin or other curved shaped, due to the higher stresses conferred on the unit by the geometrical design, these being additive to the usual coefficient of expansion stresses already present in the weld.

Several difficulties exist at present in the art of fabrication of commercial cooking or heating utensils, espe-

cially those cooking vessels subject to public display during operation.

In many cases it is highly desirable and indeed mandatory to supply a stainless steel cooker for aesthetic, cleaning and other divers purposes. Thus, breweries, distilleries, bottling plants, commissaries and other commercial outlets concerned with the preparation of cooked or pasteurized foods require vessels and equipment fabricated either entirely of stainless steel or, more economically, of a stainless steel exterior welded to a cast iron or steel base which serves as the heating surface.

A composite cooking vessel made of cast iron and stainless steel is also preferred by a great many professional chefs because of the flavour enhancement imparted to the cooked foods owing to the greater porosity of the cast iron cooking surface and its excellent ability for even heat distribution. These advantages are not as pronounced in stainless steel cooking vessels.

Composite welded utensils which continually undergo a two-stage heating and cooling cycle while in operation, place the weld seam under severe stresses due to the vast differences in the coefficients of expansion of the two dissimilar metals. For example, in a welded cast iron-stainless steel unit these stresses are in the order of 10^5 p.s.i. and if this exceeds the material strength of either metal, cracking or breaking will occur. For instance, the rupture modulus for Meehanite, a registered trademark for a typical cast iron found in Table I below, is only 8×10^3 p.s.i. In many cases these induced stresses will exceed the material strength of both metals. Hence, welded dissimilar metal utensils such as commercial frying pans, autoclaves, chemical reactors and the like are all subject to weld defects while in continued operation.

In view of the prior art discussion outlined above, it is a prime object of the invention to provide a method for welding stainless steel to cast iron by the laminar insertion of a hollow-core, ferritic metal, tubular expansion joint between the respective workpieces which, after welding, is capable of absorbing the induced stresses of heating and cooling effects on the weld seam without any deleterious affects thereto.

A second object of the invention is to provide welded heating or cooking utensils comprised of stainless steel-cast iron which will not suffer weld defects such as cracking or breaking while in operation.

Another object of the invention is to provide commercial type cooking utensils having a stainless steel exterior and a cast iron cooking surface which are easy to clean, economical to manufacture, acceptable to master chefs and have the desirable weld characteristics described beforehand.

It is a further object of the invention to provide a commercial type frying pan unit having a stainless steel exterior and a welded cast iron cooking surface which will not crack or fault at the weld seam during continued operation.

STATEMENT OF THE INVENTION

The present invention seeks to overcome the difficulties encountered in the prior art by a simple yet novel expedient. This expedient resides in the laminar insertion of a wrought-iron or steel tubular hollow-core expansion joint section having the shape of a substantially flattened oval and sandwiching and welding it between the base metal which is a cast iron and the stainless

steel which may be either an austenitic or a martensitic stainless steel. The hollow-core, tubular expansion joint section fulfils two functions simultaneously — firstly, being interstitial in carbon content composition (about 2.5 percent), it bonds well to each of the dissimilar metals; secondly, being hollow-cored, the expansion joint section is able to absorb the stresses resulting from the heating and cooling cycle of a cooking utensil without undue transfer of these stresses to the welded zone. Although consumable electrodes which are capable of bonding well to both the stainless steel and cast iron are well known and widely used in the art, the weldment formed therefrom is necessarily solid and inflexible, whereas the combining of a hollow-core member into the weld seam, i.e., the expansion joint, provides a very slight degree of flexibility after it is laminated and bonded in the welded article.

DESCRIPTION OF THE DRAWINGS

The invention may be further understood from a description of the accompanying drawings which are designated as FIGS. 1-3, wherein;

FIG. 1 is a fragmentary perspective view of the tubular expansion joint,

FIG. 2 is an exploded portion of a cross-sectional elevation of the welded zone taken along the line 2-2' of FIG. 3,

FIG. 3 is a perspective view of a commercial frying pan utensil.

DESCRIPTION OF A PREFERRED EMBODIMENT

A preferred embodiment of the invention is now described having reference to the foregoing drawings. In FIG. 1 the expansion joint section 1 has been preformed into a substantially flattened-oval shape from standard wrought iron tubular pipe or fabricated by rolling and shaping from flat wrought iron sheeting. Alternatively, the expansion joint section 1 may be preformed from standard steel tubing of appropriate diameter which is in proportion to the dimensions of the welded article. The wall thickness of joint 1 must also be of sufficient width so as to prevent any "burn through" of the joint member during the welding process. In the frying pan constructions described herein, this wall thickness is at least one-sixteenth inch thick. The wrought iron pipe used for the expansion joint in a typical frying pan fabrication is rated by the ASME Boiler Code as SA-53. The tubular, hollow-core, flattened-oval shaped expansion joint member 1 is next welded around the peripheral edge of a rectangular shaped, flat cast iron sheet 2, shown in fragmentary view in FIG. 2, and forms the frying pan cooking surface of the frying pan utensil 6 depicted in FIG. 3. The weld is effected by conventional arc or torch welding techniques, employing a consumable electrode or rod as the weldment 5', and capable of bonding to both the cast iron and expansion joint members. In the frying pan fabrications the rectangular cast iron cooking surface sheets used are normally at least three-fourth inch thick.

An abutment lip 3 illustrated in FIG. 2 has been formed beforehand by reducing and indenting a portion of the wall section 4 of the stainless steel jacket housing of the frying pan utensil 6 shown in FIG. 3. This abutment lip 3, projects inwardly around the entire wall section 4, and is positioned approximately midway between the top and bottom of the housing.

The abutment lip 3 serves as a tensioning means to prevent the stainless steel jacket housing from distorting during the final welding stage. The cast iron sheet 2, engirdled with the tubular expansion joint 1, is next aligned and fitted into position with the abutment lip 3 of the stainless steel housing wall 4 and welded in place, using a consumable electrode which is an SAE 310 or 316 stainless steel rod to form the weldment 5, having reference to FIG. 2. The weld seam can then be hand or machine finished to form a smooth integral unit structure comprised of the stainless steel jacket housing, the welded expansion joint and the cast iron cooking surface. FIG. 3 illustrates a completed frying pan utensil, designated 6 in the drawing, and equipped with an electric heating source (not shown) housed in the trunion gear box 8' of the tilting trunion stand 12. The electric heater is controlled by an ON-OFF regulator switch 7, surmounted on the front panel of the trunion gear box 8'. The other trunion gear box 8, carries a crankwheel 9 attached to a crankshaft (not shown) which tilts the cooking vessel portion by the gear train in the trunion box, when desired. The frying pan is also fitted with a hinged lid 11, and a pouring spout (un-numbered).

The cast iron used in the frying pan fabrications is described in the literature as Meehanite type GC-40 and its physical properties are listed below in Table I. Conventional grey casting have also been utilized in these fabrications.

TABLE I

TENSILE STRENGTH—psi	40,000
PROPORTIONAL LIMIT—psi	
0.01% Permanent set	14,500
MODULUS OF ELASTICITY—psi	16,500,000
MODULUS OF RIGIDITY—psi	7,250,000
POISSON'S RATIO	30
MODULUS OF RUPTURE—psi	80,000
COMPRESSION STRENGTH—psi	150,000
FATIGUE STRENGTH—psi	17,500
SHEAR STRENGTH—psi	40,000
IMPACT STRENGTH—Charpy ft. lbs.	4.5
SINGLE IMPACT—Ized. 798" Dia.	
Unnotched Bar	12-20
BRINELL HARDNESS (normal approx.)	up to 160
MACHINABILITY RATING	47
TORSIONAL STRENGTH 0.75" Dia. X 14.5"	
Long	
Ultimate Torsional Fiber Stress —psi	47,000
Degrees Twist	64.3
SPECIFIC GRAVITY	7.25
SOLID CONTRACTION	4/32"-5/32" per ft.
PATTERNMAKERS SHRINKAGE	1.0-1.3%

This material meets the requirements outlined in the following specifications:

ASTM	A48-60T
ASTM	A126-61T
ASTM	A159-58
ASTM	A278-61T
ASTM	A319-53
ASTM	A438-60T
FEDERAL	QQ-1-652a

The stainless steels used in the frying pan fabrications were of the chromium-nickel stainless steel series, whose compositions are listed in Table II. When martensitic stainless steels of the 400 series (0.08-1.10 percent carbon) were employed in trial welds, equally satisfactory results in respect of weld failure were obtained.

TABLE II.—CHEMICAL REQUIREMENTS OF STAINLESS STEEL

Type	Maximum percent					Percent	
	Carbon	Manga- nese	Phos- phorus	Sulfur	Silicon	Chromium	Nickel
302-----	0.15	2.00	0.045	0.030	1.00	17.00-19.00	8.00-10.00
304-----	0.08	2.00	0.045	0.030	1.00	18.00-20.00	8.00-12.00
304L-----	0.03	2.00	0.045	0.030	1.00	18.00-20.00	8.00-12.00
305-----	0.12	2.00	0.045	0.030	1.00	17.00-19.00	10.00-13.00
309S-----	0.08	2.00	0.045	0.030	1.00	22.00-24.00	12.00-15.00

In summary the invention provides a method of fabri-
cating stainless steel-cast iron cooking utensils, with
economical savings in construction materials, taste en-
hancement of the prepared foods, aesthetic utility and
non-failure of the weld seams on prolonged usage.

I claim:

1. In a welded stainless steel - cast iron cooking uten-
sil, comprising a cast iron cooking surface sheet and a
stainless steel jacket housing, having an integrally
formed abutment lip projecting inwardly from the
jacket housing exterior, and following the direction of
the weld seam, the improvement consisting of a tubu-
lar, hollow-core, ferritic metal expansion joint member
conforming to the respective circumferences of the
jacket housing abutment lip and the edge of the cast
iron cooking surface sheet, welded and sandwiched
therebetween, thereby forming an integral unit struc-
ture of the jacket housing wall, expansion joint and cast
iron cooking surface, said cooking utensil being
equipped with an electric heating source.

2. The improvement as claimed in claim 1, wherein
the expansion joint is a ferritic metal having a carbon
content of less than 3 per cent.

3. In a welded stainless steel-cast iron frying pan
equipped with an electric heating source and a tiltable
trunion stand, said frying pan comprised of a flat cast

iron cooking surface sheet and a stainless steel jacket
housing having an integrally formed abutment lip pro-
jecting inwardly from the jacket housing exterior and
following the direction of the weld seam, the improve-
ment consisting of a tubular, hollow-core, ferritic metal
expansion joint member conforming to the respective
circumferences of the jacket housing abutment lip and
the edge of the cast iron cooking surface sheet, welded
and sandwiched therebetween, thereby forming an in-
tegral unit structure of the jacket housing wall, expan-
sion joint and cast iron cooking surface.

4. The improvement as claimed in claim 3, wherein
the expansion joint is shaped wrought iron tubing.

5. The improvement as claimed in claim 3, wherein
the expansion joint is shaped wrought iron sheet.

6. The improvement as claimed in claim 3, wherein
the expansion joint is shaped steel tubing.

7. The improvement as claimed in claims 3, wherein
the stainless steel jacket housing and the flat cast iron
cooking surface sheet are of orbicular shape.

8. The improvement as claimed in claims 3, wherein
the stainless steel jacket housing and the flat cast iron
cooking surface sheet are substantially rectangular in
shape.

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