June 10, 1930. F. JARDINE 1,763,523

PISTON

Original Filed March 11. 1920 2 Sheets-Sheet 1

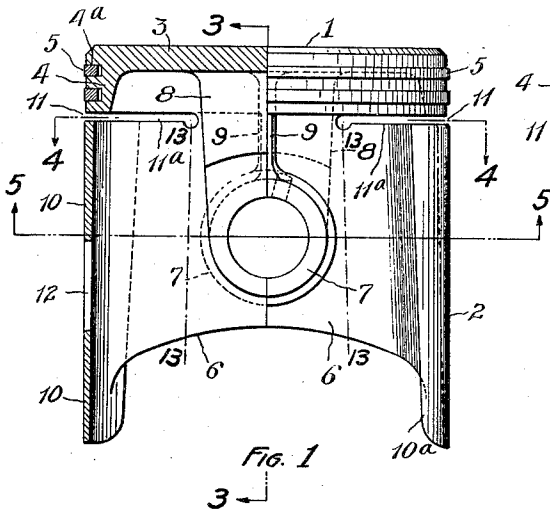


FIG. 1

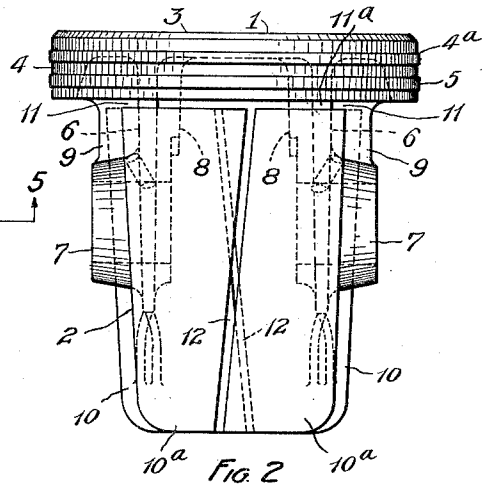


FIG. 2

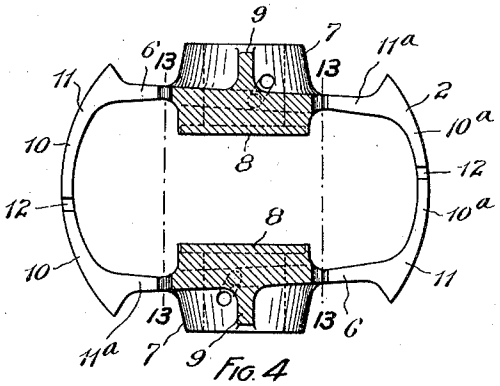


FIG. 4

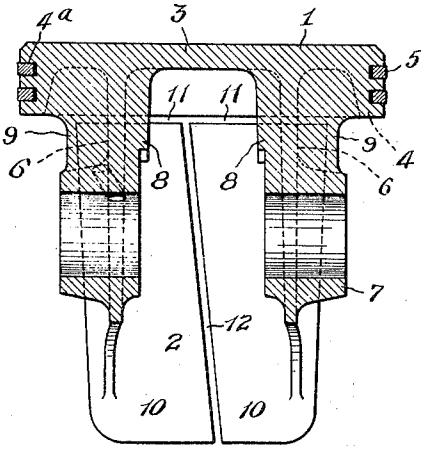


FIG. 3

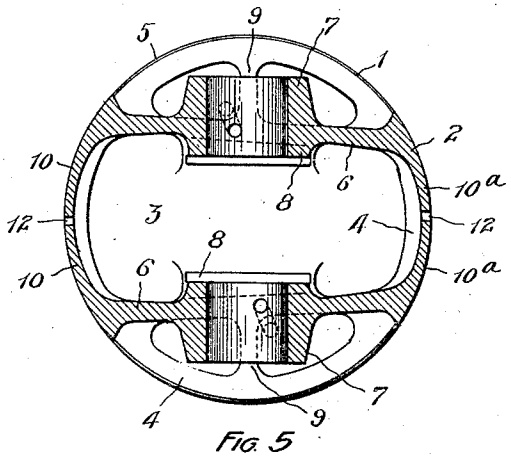


FIG. 5

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PISTON

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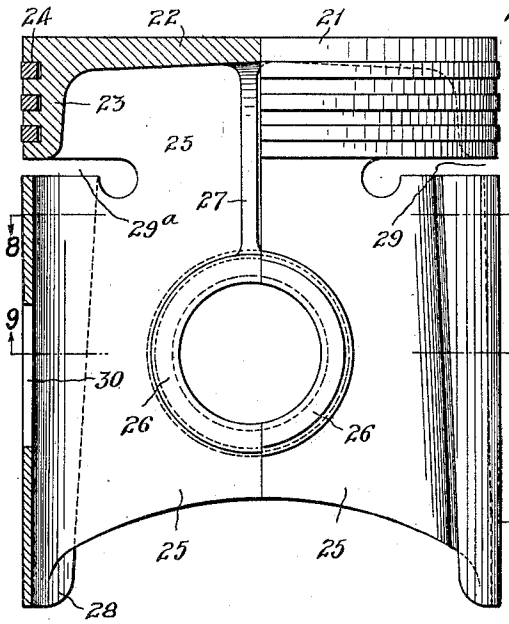


FIG. 6

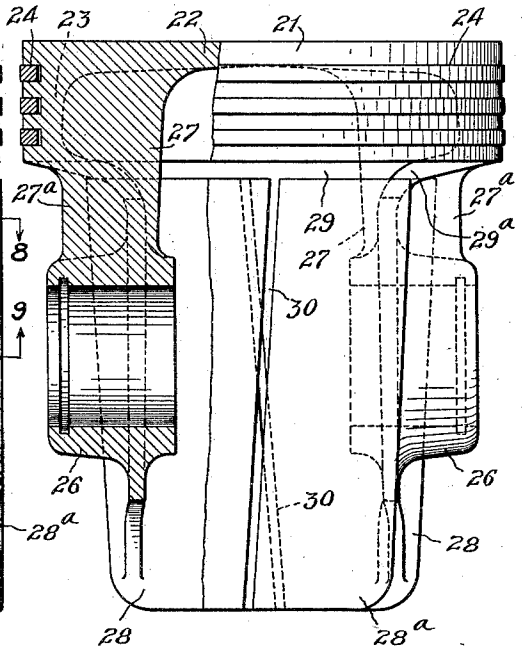


FIG. 7

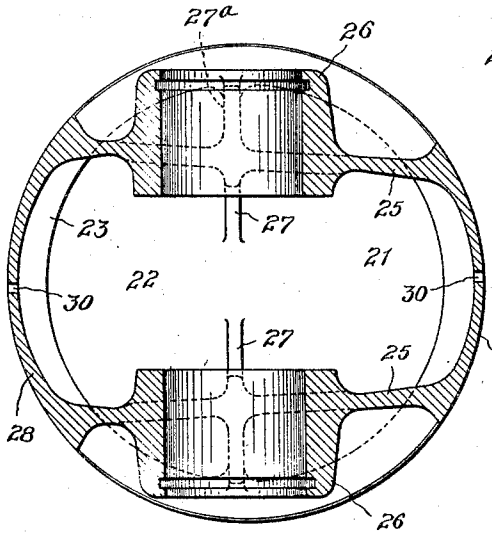


FIG. 9

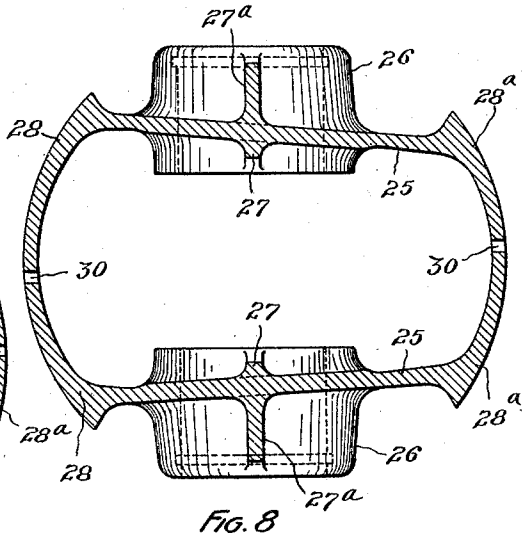


FIG. 8

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Patented June 10, 1930 1,763,523

UNITED STATES PATENT OFFICE

FRANK JARDINE, OF CLEVELAND, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE CLEVELAND TRUST COMPANY, AS TRUSTEE, OF CLEVELAND, OHIO, A CORPORATION OF OHIO

PISTON

Application filed March 11, 1920, Serial No. 364,997. Renewed March 9, 1921. Serial No. 450,898.

My invention relates to pistons for internal combustion engines and especially to pistons formed of light weight metals or alloys.

The invention has for its chief object the construction of a light alloy piston which, with relatively small initial clearance, will operate satisfactorily at all temperatures in an engine cylinder.

Another object of the invention is to produce a piston of the character noted that will lend itself to economic methods of manufacture.

Because of the high co-efficient of expansion of suitable light alloys such as aluminum alloys, as compared with iron, it is often difficult to fit an internal combustion engine satisfactorily operable with iron pistons, with light alloy pistons so that such pistons will not be noisy and will not pump oil when cold, or will not stick or score the cylinder wall when heated. I have found that these difficulties can be overcome by constructing a piston with its skirt or guide portion supported and slotted or divided in a manner to permit deformation and deflection of parts thereof without interfering with the performance of the essential functions of the respective parts.

To facilitate an understanding of the invention two forms or embodiments thereof are described hereinafter and are illustrated in the accompanying drawings in which

Fig. 1 is a view partly in side elevation and partly in section of a piston constructed in accordance with my invention.

Fig. 2 is a side elevation of the same piston viewed at right angles to Fig. 1.

Fig. 3 is a section on the line 3—3 of Fig. 1.

Fig. 4 is a section on the line 4—4 of Fig. 1.

Fig. 5 is a section on the line 5—5 of Fig. 1.

Fig. 6 is a view partly in side elevation and partly in section of a piston of modified form.

Fig. 7 is a side elevation of the same viewed at right angles to Fig. 6 and with parts broken away and shown in section.

Fig. 8 is a section on line 8—8 of Fig. 6.

Fig. 9 is a section on line 9—9 of Fig. 6.

Referring first to Figs. 1 to 5, the piston shown comprises a head portion 1 and a guide or skirt portion designated in its entirety by 2. The head portion consists of a head disc 3 and a peripheral flange 4 in which are grooves 4^a for the ordinary piston rings 5. On the lower face of the head disc 3 are formed two depending webs 6 integral with the disc. These webs carry bosses 7 which are adapted to receive the ordinary wrist pin. Ribs 8 may be provided along the webs 6 between the head disc and the bosses for strengthening the webs 6 and supporting the inner ends of the bosses. Additional ribs 9 may be formed on the outer sides of webs 6 as shown to strengthen them and to support the outer ends of the bosses.

The guide portion 2 comprises two pairs of guide segments 10 and 10^a curved to conform to the engine cylinder, one pair being located on either side of the bosses. The segments are integral with the webs 6 and are supported and connected to the head portion 1 by means of these webs. The segments at their upper ends are separated from the flange 4 of head portion 1 by slots 11 and are further isolated from the head by slots 11^a formed in webs 6. The segments of each pair are separated from one another by a longitudinally extending slot 12, said slot preferably being inclined or spirally arranged as shown. In the construction shown the guide portion formed by segments 10^a is designed to take the diagonal thrust of the piston rod during the compression stroke of the engine and as said thrust is less than the corresponding thrust during the explosion stroke, said portion 10^a is made narrower circumferentially than the other portion 10 so as to save weight.

The flange 4 of the head portion 1 has a smaller outer diameter than the guide portion 2, the diameter of the latter being only slightly smaller than the internal diameter of the cylinder in which it is to function.

In the operation of an internal combustion engine the piston usually is heated to a higher temperature than the cylinder wall and expands radially to a greater amount than the cylinder. This expansion reduces the clearance between the piston skirt or guide part and the cylinder wall and in the case of pistons not constructed according to

my invention, if the initial clearance provided is small, scoring of the cylinder walls or piston, or seizure of the piston in the cylinder may result. With my invention, however, the guide segments 10, 10ª, are capable of deformation or displacement as the piston guide parts expand, the segments being forced toward one another so as to tend to close up the slots 12. The webs 6 and guide segments preferably are so designed that this displacement of the segments 10, 10ª, is permitted by virtue of a bending of the webs 6 at points remote from the guide segments. To this end, as shown in Fig. 4, the thickness of the guide segments is increased toward the webs 6 and the webs 6 are decreased in thickness from the guide portions inward toward the bosses to points in line with the inner ends of the slots 11ª. This gives in effect a cantilever structure weakest at its support, namely, along the dotted lines 13 in Figs. 1 and 4. Thus the reaction force of the cylinder wall on the outer faces of the guide segments as the piston expands tends to cause bending of the webs 6 along said lines 13. Due to the bending of the web sections 6 and the forcing together of each pair of segments, the guide part of the piston may undergo a considerable thermal expansion without a corresponding increase in the outer diameter thereof and thus a small initial clearance can be used without danger of scoring or seizure of the piston.

By variation of the thickness and design of the webs 6 and the location of the slots 11ª therein, the force necessary to cause the guide segments 10 and 10ª to approach one another along the slot 12, or in effect to maintain the outer diameter of the piston substantially constant, can be easily regulated. The webs 6 will tend to bend along a line extending vertically downward from the ends of slots 11ª and if said slots are terminated closer to the guide segments 10, 10ª the region of bending will be moved outward correspondingly. Likewise a thickening of the webs 6 near the bosses will tend to move the point of bending or flexing closer to the guide segments 10, 10ª. An increase of the thickness of the webs 6 obviously will increase the force necessary to cause the guide segments 10, 10ª to approach one another along the slot 12.

In Figs. 6 to 9 a modified form of piston is shown. The head portion 21 is formed with a head disc 22 and a depending peripheral flange 23 in which may be formed grooves 24 for the ordinary piston rings. Depending webs 25 are formed at diametrically opposite parts of the lower edge of the peripheral flange 23. These webs carry bosses 26 for the customary wrist pin, the inner ends of the bosses being supported by ribs 27 which join the webs 25 and extend from the inner ends of the bosses 26 to the lower side of the head disc 22, while the outer ends of said bosses are supported by ribs 27ª.

On either side of the bosses 26 are formed pairs of guide segments 28 and 28ª similar to those shown in Figs. 1 to 5. These segments are united with webs 25 as shown and are separated from the flange 23 by slots 29 and further isolated from the head by slots 29ª in the walls 25. The guide segments of each pair are separated from one another by longitudinally extending slots 30.

It will be seen that this last form of construction is based upon the same principles as the first form and further detailed description is therefore unnecessary. The main difference between the last form of construction and that first described resides in the webs 35 which support the wrist pin bosses and the guide portions, said walls being joined to the head structure at the lower edge of the ring flange 23 rather than springing from the head disc as in the first form of construction.

From the foregoing description the operation of pistons embodying my improvements will readily be understood. It will be seen that an aluminum alloy piston embodying my invention can be fitted to the engine cylinder with a very small clearance and that compensation for the relatively large thermal expansion of the guide section of the piston is provided by the displacement of the guide segments which results from the reaction force of the cylinder wall on the outer faces of the guides. As above indicated the reaction force necessary to displace the guide parts and effect such compensation can readily be controlled by properly forming and proportioning the guide parts. In this connection it will be obvious to the designer that account must be taken of such factors as compression pressures, piston diameter and piston stroke as determining the lateral thrust to which the guide parts will be subjected. It is obvious that the compensating displacement of the guide parts should require a thrust great enough to insure adequate mechanical strength of the piston and small enough to obviate scoring of the piston and cylinder or seizure of the piston.

While I have shown my invention applied to the slipper type of piston as distinguished from the skirt type it is to be understood that the invention is essentially applicable to other forms of construction, the scope of the invention being indicated by the appended claims.

What I claim is—

1. In a piston for an internal combustion engine, the combination of a head having ring grooves therein, a plurality of webs integral with said head and having diametrically opposite piston pin bosses therein, a skirt integral with said webs relieved adjacent said webs and separated from the head by cir-

cumferential slots and provided with a longitudinal slot connecting the lower end of the piston with one of the circumferential slots.

2. In a piston for an internal combustion engine the combination of a head comprising a head disc and a peripheral flange having ring grooves therein, a pair of chordal webs, substantially rectangular in shape and located opposite each other in the piston, connected integrally at their upper edges to the peripheral flange of the piston, diametrically opposite wrist pin bosses, one in each of said webs, a skirt for said piston integrally connected to each of the side edges of the webs and cut away so as to expose each of the rectangular webs and the piston pin bosses from the outside of the piston, said piston being provided with circumferential slots between the skirt and head and with a longitudinal slot extending from one of the circumferential slots to the open end of the piston.

3. An internal combustion engine piston comprising a head having a depending ring flange, webs integrally cast to the ring flange and depressed within the circumference defined by the ring flange, wrist pin bosses cast in the webs, and curved guide means integrally cast to the webs and provided with a longitudinal slit disposed between the ends of the webs on one side of the piston, the outer surface of the guide means being disposed in a circumference outwardly of the outer surface of the webs and merging into the latter at included angles sufficiently great to permit the removal of a permanent mold part used to form the outer surface of the piston.

4. In a piston for an internal combustion engine, the combination of a head having a depending circumferential flange provided with ring grooves on the exterior thereof, chordal webs integral with the head and depending therefrom in opposite positions, piston pin bosses, one located in each web opposite each other, a skirt portion cut away from the head to expose the bosses in the webs and provided with curved bearing faces integral with the webs and connected to the ends of the webs opposite each other, each of said bearing faces being separated from the head except for the integral connection through the webs and one of said bearing faces having a substantially vertical slot therein.

5. In a piston for an internal combustion engine, the combination of a head having a depending circumferential flange provided with ring grooves on the exterior thereof, chordal webs integral with the head and depending therefrom in opposite positions, piston pin bosses one located in each web opposite each other, ribs integral with and substantially perpendicular to the webs joining the webs and the head, a skirt portion cut away from the head to expose the bosses in the webs provided with curved bearing faces integral with the webs and connected to the ends of the webs opposite each other, each of said bearing faces being separated from the head except for the integral connection through the webs and one of said bearing faces having a substantially vertical slot therein.

6. In a piston for an internal combustion engine, the combination of a head having a depending circumferential flange provided with ring grooves on the exterior thereof, chordal webs integral with the head and depending therefrom in opposite positions, piston pin bosses, one located in each web opposite each other, ribs integral with and substantially perpendicular to the webs joining the webs, the bosses and the head together, a skirt portion cut away from the head to expose the bosses in the webs and provided with curved bearing faces integral with the webs and connected to the ends of the webs opposite each other, each of said bearing faces being separated from the head except for the integral connection through the webs and one of said bearing faces having a substantially vertical slot therein.

7. A piston for an internal combustion engine comprising a head portion having a depending ring flange, a skirt portion, said skirt portion comprising a pair of substantially parallel webs carried by the head portion and provided with opposed wrist pin bosses, bearing portions carried by the ends of said webs and separated from the head by air gaps, the laterally outer faces of said web portions being free from laterally overhanging edge portions of the bearing faces, one of said bearing faces being provided with a longitudinal slot disposed intermediate the end portions of said bearing face.

8. In a piston for an internal combustion engine, the combination of a head having a cylindrical ring flange, oppositely disposed webs integral with the flange and carrying diametrically opposite piston pin bosses, a skirt integral with said webs and cut away to expose the sides of said webs and separated from the ring flange by circumferential slits and provided with a longitudinal slit disposed between the ends of the webs.

9. In a piston for an internal combustion engine, the combination of a head comprising a disc and a peripheral flange having ring grooves therein, a pair of chordal webs connected to the flange of the head by outwardly flaring extensions, oppositely disposed wrist pin bosses in the webs, and a cylindrical skirt cut away to expose the webs and integrally connected to the ends of the latter, the skirt being separated from the head between the said webs by circumferential slits and the skirt having a longitudinally extending slit disposed between the ends of the webs on one side of the piston.

10. In a piston for an internal combustion engine, the combination of a piston head including a depending ring flange, oppositely disposed webs depending from the ring flange and disposed inwardly thereof, wrist pin bosses in the webs, and curved bearing means integrally connected to the webs and separated from the head by air gaps extending circumferentially of the piston between the ends of the webs, the said bearing means having a slit located between the ends of the webs and extending in a direction lengthwise of the piston.

11. In a piston of an internal combustion engine, the combination of a piston head having a cylindrical ring flange depending therefrom, webs integral with the flange extending convergingly inwardly of the piston from the opposite portions of the flange and then lengthwise of the piston in substantially parallel arrangement, wrist pin bosses in the webs, and a skirt joined to the ends of the webs on opposite sides of the bosses and cut away to expose substantially all of the sides of the webs, all the foregoing parts being integrally connected together, there being circumferentially extending air gaps separating the head and skirt between the webs and a slot in one side of the skirt between the ends of the webs and extending in a direction lengthwise of the piston.

12. In a piston for an internal combustion engine, the combination of a piston head comprising a disc with a depending peripheral ring flange, a skirt separated from the head by circumferentially extending air gaps, chordal webs integrally connected at their ends to the skirt with their outer surfaces near the points of connection with the skirt diverging outwardly to merge into the outer surfaces of the skirt, wrist pin bosses integrally formed with the webs, and integral connections between the depending flange of the head and the adjacent ends of the webs, said connections extending from the flange inwardly and lengthwise of the piston and merging into the webs with outwardly diverging surfaces, the skirt having a longitudinally extending slit formed on one side thereof between the ends of the webs.

In testimony whereof, I hereunto affix my signature.

FRANK JARDINE.

DISCLAIMER

1,763,523.—*Frank Jardine*, Cleveland, Ohio. PISTON. Patent dated June 10, 1930. Disclaimer filed April 2, 1941, by the assignee, *The Cleveland Trust Company.*

Hereby enters this disclaimer to the following parts of the claims in said specification, to wit, from the scope of:

Claim 1, all pistons except those having webs each of which comprises two skirt-supporting sections extending oppositely from the central strengthening and stiffening boss, and at least one of which sections is in some portion thereof deformable, resulting from—and only sufficiently to permit—the displacement and deflection of the guide segments under the thermal expansion of the piston and the reactive force of the cylinder wall.

Claim 2, all pistons except those whose webs are each strengthened and stiffened by a central boss and bendable in a section between boss and skirt, to permit deformation and deflection of skirt and supports, due to the reaction force of the cylinder wall.

Claim 3, all pistons except those whose webs are stiffened and strengthened by the centrally carried bosses and which have deformable sections intermediate the central portion and the skirt attachment.

Claim 4, all pistons except those whose webs are of such thickness and form as to permit only that bending which will maintain the outer diameter of the piston substantially constant in operation under the conflicting stresses of piston expansion and cylinder wall reaction.

Claim 5, all pistons except those whose webs have a bendable section and are stiffened in the center by a rib.

Claim 6, all pistons except those whose webs are centrally stiffened by bosses and ribs and which have a portion bendable by deformation under the displacement and deflection of the skirt in operation resulting from cylinder wall reaction.

Claim 7, all pistons except those whose webs are so formed and deformable as to constitute support on the cantilever principle as between the central boss-stiffened portion of the web and the deflectable guide segments when constrained by the cylinder wall reaction.

Claim 8, all pistons except those having webs each of which comprises two skirt-supporting sections extending oppositely in the same plane from the central strengthening and stiffening boss, and at least one of which sections is in some portion thereof deformable, resulting from—and only sufficiently to permit—the displacement and deflection of the guide segments under the thermal expansion of the piston and the reactive force of the cylinder wall.

Claim 9, all pistons except those in which the webs are so formed and so deformable in operation as to permit compensating displacement of the guide sections, through deformation and deflection of the parts, by forces small enough to obviate scoring or seizure but which webs are sufficiently resistant to insure the adequate mechanical strength of the piston, whereby the piston can be fitted to the engine cylinder with a very small initial clearance.

Claim 10, all pistons except those whose webs are bendable in a section thereof adjacent to the bosses to permit displacement of parts of the skirt due to the reaction force of the cylinder wall on the outer faces of the skirt portion.

Claim 11, all pistons except those having webs each of which comprises two skirt-supporting sections extending oppositely from the central strengthening and stiffening boss, and which skirt-supporting sections are in some portion thereof bendable only sufficiently to permit that deformation and displacement of such supports and guide segments which result from the opposing stresses of piston expansion and cylinder wall reaction.

Claim 12, all pistons except those whose webs have a bendable section and are stiffened in the center by a rib.

[*Official Gazette April 29, 1941.*]