April 16, 1935. A. GIESL-GIESLINGEN 1,998,006

LOCOMOTIVE DRAFT APPLIANCE

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FIG. 1

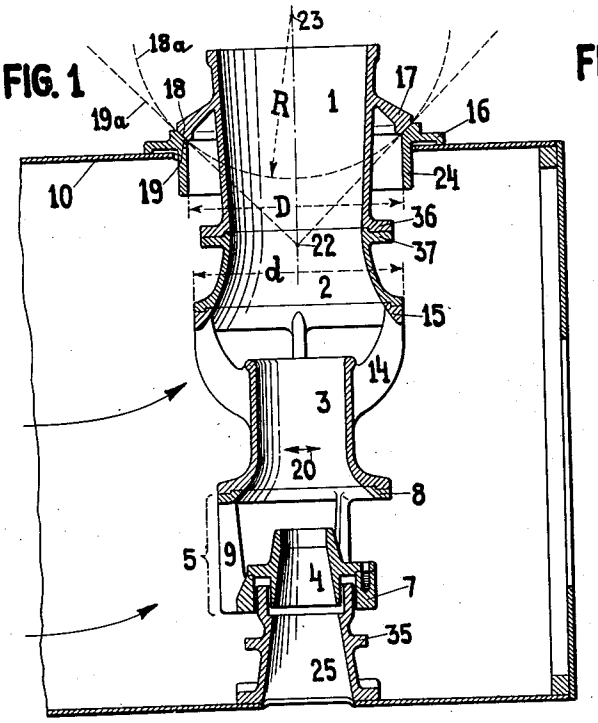
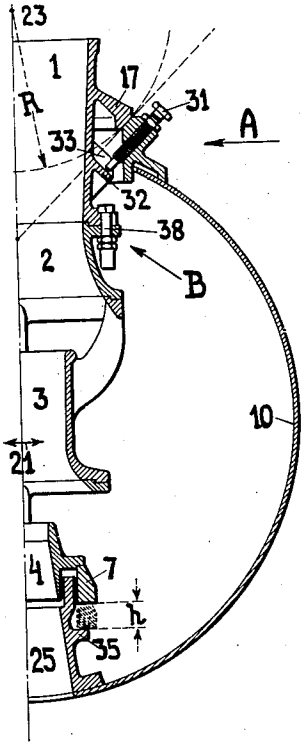


FIG. 2



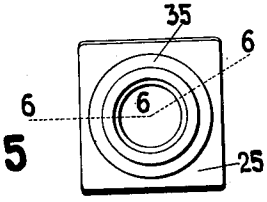


FIG. 5

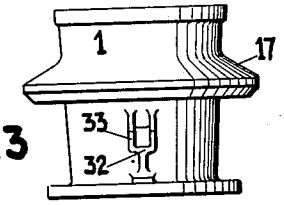


FIG. 3

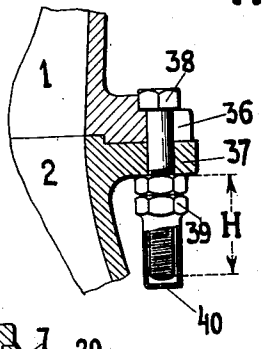


FIG. 4

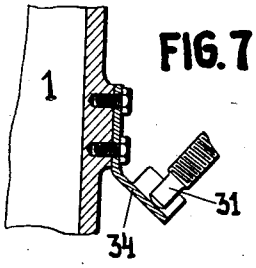


FIG. 7

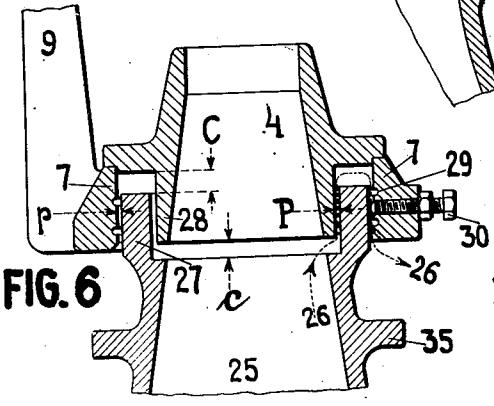


FIG. 6

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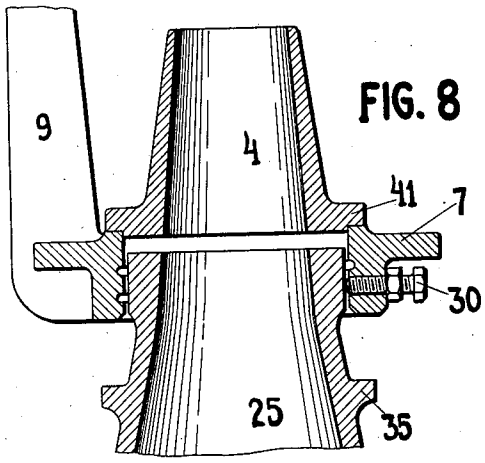

FIG. 8

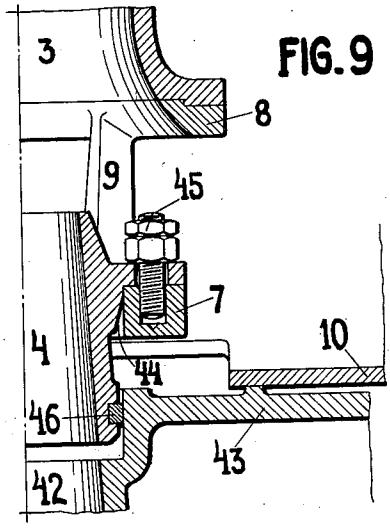

FIG. 9

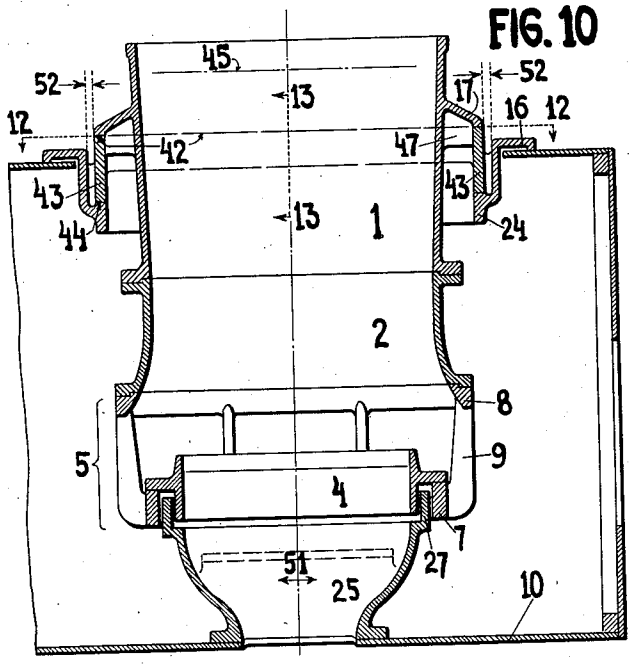

FIG. 10

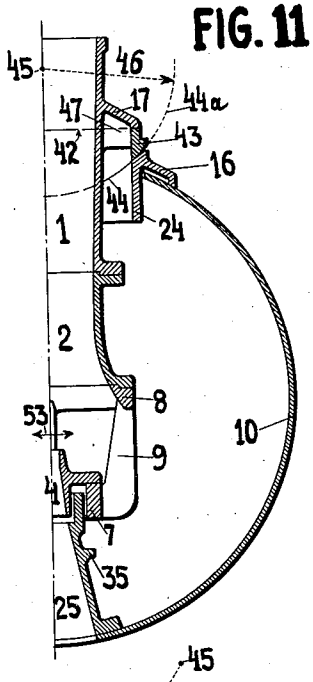

FIG. 11

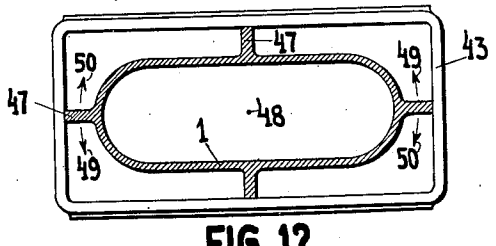

FIG. 12

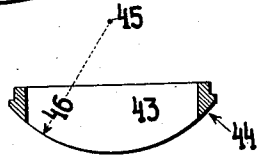

FIG. 13

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FIG. 14

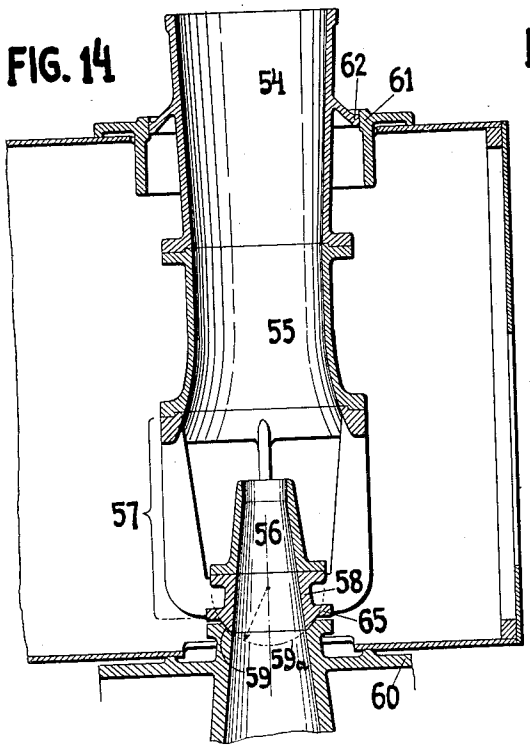
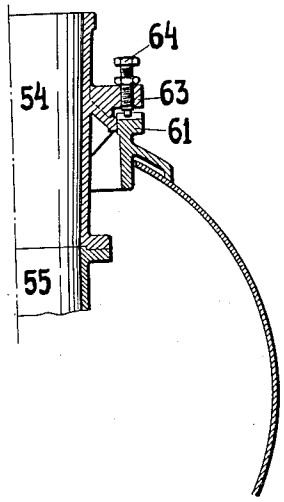


FIG. 15



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Patented Apr. 16, 1935 1,998,006

UNITED STATES PATENT OFFICE

1,998,006

LOCOMOTIVE DRAFT APPLIANCE

Adolf Giesl-Gieslingen, New York, N. Y.

Application February 4, 1933, Serial No. 655,161

10 Claims. (Cl. 230—96)

My invention relates to steam boilers for locomotives in which the gases and products of combustion are discharged into the atmosphere by a steam jet flowing through the so-called draft appliance.

In current practice, a smokestack is secured to the top of the so-called smokebox or discharge end of the locomotive boiler. The combustion gases are ejected into the atmosphere through said smokestack, by a steam jet emerging from an exhaust nozzle which is secured to the lower part of the smokebox or to a saddle supporting the same. If intermediate nozzles are placed between exhaust nozzle and smokestack for the purpose of increasing the action of the steam jet or for other reasons, said intermediate nozzles are usually held in suspension by bracings extending to the smokebox walls or to stack and exhaust pipe; sometimes an intermediate nozzle is supported only by the exhaust pipe without being connected with any other parts.

These usual constructions do not permanently secure that co-axial and otherwise accurate relative position of the parts composing the draft appliance which is indispensable for optimal function and efficiency. It is well known to those familiar with locomotive operation that between engines of the same class, all built to the same specifications by the same builder, there are always remarkable differences in steaming qualities: some engines appear to be "better steamers" than others which have to be equipped with smaller exhaust nozzles in order to match the former in steaming capacity. It is very undesirable to have engines with different steaming qualities and it is equally undesirable to employ individual exhaust nozzles for every engine because in that case the tendency of the engine crews is toward smaller nozzle sizes, resulting in excessive back pressure and fuel losses or requiring costly supervision.

I have discovered that said individuality in the steaming qualities of seemingly identically built locomotives is almost exclusively due to minor differences in the relative location of the parts composing the draft appliance and, to some extent, also to differences in the dimensions of the rough castings employed. The smokebox shell upon which the stack is mounted is necessarily thin and does not accurately keep its original shape on account of the extreme heat and cold and corrosion to which it is subjected, and under the influence of frequent repair work. Moreover, the nature of the usually employed exhaust nozzle and exhaust standpipe is such that it is not possible by measurement on the cold engine alone to determine whether the steam flow through the draft appliance will be as symmetrical as it should: I found that faults can be reliably detected only by inserting instruments into the steam flow while the locomotive is working, a procedure which is not practicable in regular service and moreover does only indicate existing faults but cannot prevent them.

It is a primary object of by invention to create locomotive draft appliances the function of which cannot be impaired in any way by the commonly occurring distortions of the locomotive smokebox nor, within prevailing limits, by inaccurate application.

It is another object of my invention to make the draft appliance readily interchangeable between various locomotives, thereby greatly reducing the cost of labor and of materials to be held in stock.

A further object is to make draft appliances suitable for specialized production, whereby a uniform and high-grade product of maximum efficiency may be created, and the present well known state of confusion in the art may be ended. The importance of this object becomes apparent if it is considered that a modern locomotive draft appliance is a gas pump developing a useful performance of 300 to 500 horsepower, and that a similar amount of power is often lost in the present inadequate devices and is thus taken away from the revenue-producing power of the locomotive.

Other objects and improvements will appear later in this specification.

To these ends, my invention provides novel means of connection between the draft appliance and its various parts and the smokebox and steam passages, and I prefer to form the draft appliance as a self-contained ejector as will now be described.

In the accompanying drawings, Fig. 1 is a longitudinal central section through a locomotive smokebox equipped with a preferred form of my invention, Fig. 2 is a central transverse section corresponding thereto. Figures 3 to 6 are corresponding details, Fig. 3 giving a view of the stack alone as it would appear when removed from the smokebox and seen from the direction of the arrow A in Fig. 2, Fig. 4 is an enlarged reproduction of the detail B in Fig. 2, Fig. 5 is a plan view of the exhaust standpipe alone and Fig. 6 an enlarged vertical central section of the said

standpipe and adjacent parts along the line 6—6—6 in Fig. 5.

Fig. 7 shows in section, a flexible lug in lieu of the solid lug cast on the stack as seen in Figures 3 and 2.

Fig. 8 is a modified construction of the exhaust stand pipe otherwise corresponding to Fig. 6.

Fig. 9 is a modification of the lower part of the draft appliance, shown in vertical central section.

Figures 10 to 13 illustrate an example of a draft appliance according to my invention having an oblong cross section. Fig. 10 being a longitudinal section, Fig. 11 a transverse section at a right angle thereto, Fig. 12 a horizontal cross section along the line 12—12 in Figure 10, and Fig. 13 a vertical cross section through an auxiliary saddle along the line 13—13 in Fig. 10.

Fig. 14 shows a modified example of my invention in longitudinal section, and Fig. 15 is a partial section at a right angle thereto.

Referring to Figures 1 and 2, a preferred embodiment of my invention is shown together with the front part of a conventional locomotive smokebox, formed by a cylindrical shell 10. The combustion gases enter from the left of Fig. 1 as indicated by the arrows, whereupon they are being entrained and ejected into the atmosphere by the action of the steam jet flowing through the draft appliance which is composed of the following main parts: the smokestack 1, the stack extension 2, the intermediate nozzle 3, and the exhaust nozzle 4. The latter is securely held by the lower ring 7 of the basket 5 which consists further of an upper ring 8 that is bolted to the intermediate nozzle and connected with the lower ring 7 by arms 9; likewise, the intermediate nozzle 3 carries arms 14 connecting it with a ring 15 that is bolted to the stack extension. Thus, the various parts of the draft appliance are united into one self-contained, rigid structure forming a complete ejector and hereinafter so called; said ejector can be assembled and its alignment may be inspected outside and entirely independent of the locomotive.

The ejector being practically inflexible, I provide means for so holding it within the smokebox that the latter may expand or contract or deform within all practical limits without affecting the application of said ejector and without creating internal stresses in the same, while always maintaining proper tightness of its steam and gas connections in addition to other advantages.

In the embodiment of my invention shown in Figures 1 and 2, the weight of the whole ejector rests on the saddle 16 by means of the flange 17 projecting from the stack. The contact surfaces 18 of the stack and 19 of the saddle are formed in such a way that unimpaired contact is maintained even if the lower end of the ejector is being swung to some extent in all directions as indicated by the arrows 20 and 21. To this end, I form the contact surface 18 on the stack flange as part of a hypothetical sphere 18a with its center 23 in the center line of the stack. The seat 19 on the saddle represents parts of a hypothetical inverted cone 19a culminating in the center line of the saddle opening at 22. The radius of the sphere 18a is such as to maintain linear contact with the conical seat 19 approximately in the middle of said seat. Obviously, if the spherical contact surface 18 be one inch wide while the radius of the sphere be 15 inches, and the total length of the ejector 90 inches, the lower end of the ejector may be swung by

$$\frac{1}{2}\times\frac{90}{15}=3$$

inches out of its central position in any direction while the stack flange will maintain completely tight contact on its seat; or, more generally speaking, the ejector and its supporting saddle may be shifted from their co-axial position to a large extent. If the seat 19 is formed as part of a sphere of the same diameter R as the surface 18, then the double deviation from the co-axial position is permissible as compared with the conical seat. However, this is usually not required and I prefer a conical seat for all ordinary purposes.

I provide the saddle 16 with a strong cylindrical portion or collar 24 and I form the seat 19 on the top of this collar and as closely as possible at the junction of said collar 24 and the horizontal part of the saddle 16: thus I secure a construction of sufficient stiffness to main a true and tight seat for the ejector notwithstanding the influences of heat and of deformations of the smokebox shell.

The lower end of the ejector is hanging freely over the exhaust standpipe 25 and is connected therewith by a slip joint permitting considerable freedom of adjustment. The construction is shown in more detail in Fig. 6: Vertical clearances c and C are provided between the exhaust standpipe and the exhaust nozzle 4 which is rigidly bolted to the ring 7 of the basket. Said clearances are large enough to take care of all vertical expansion and contraction of ejector and smokebox, as well as of all differences that may be expected due to common inaccuracies in the dimensions of the smokebox. The steam entering the exhaust nozzle under pressure but already at high speed, has a tendency to move straight onward and only a negligible part may escape through the tortuous route following the arrow 26. There is a radial play p between the ring 7 and the upper rim 27 of the exhaust standpipe and a play P between said rim and the downward extension 28 of the exhaust nozzle; the outside play p is just large enough to allow for all possible deviations between the center line of the standpipe and that of the ejector: usually, 1/64" of radial play will be sufficient to permit such tolerances in the mounting of the exhaust standpipe relative to the stack saddle that said mounting may be done quickly and by cheap labor without hindrance to the proper fitting of the ejector. Grooves 29 in the inside surface of the ring 7 serve as so-called labyrinths to further retard the flow of waste steam. The inside play P is preferably larger whereby the ejector is always held in position by the ring 7 and the exhaust nozzle may be removed and reapplied with greatest ease.

A set screw 30 is shown in Fig. 6 for the purpose of bringing the ejector in definite contact with the guiding rim of the standpipe without hindering such relative movements as will necessarily occur in service under the influence of changing temperatures.

In the manner above described, flexible joints are provided between my rigid, self-contained ejector and the adjoining parts of the locomotive, in contrast with current practice where one or more parts of the draft appliance are rigidly secured to the adjoining parts of the locomotive.

The exhaust nozzle, by means of the downward

extension 28, is made as long as desirable in order to securely guide the steam jet co-axially with the ejector.

Returning now to Fig. 1: The diameter D of the saddle opening is preferably slightly larger than the largest diameter *d* of that part of the ejector which is situated within the smokebox. Thus, the complete ejector may be removed from or inserted into the smokebox by means of a crane and the interior of the smokebox may be cleared within a fraction of the time required with the presently known draft appliances where one piece after the other must be removed after loosening many bolts and connections inside. The ejector is properly and tightly held in place by its own weight and there is no need for any method of fastening. However, as a safety measure and to prevent the device from turning around its axis, I prefer to use at least one set screw 31 (Fig. 2) acting against a lug 32 (Figures 2 and 3) which latter is provided with vertical ribs 33. This set screw does not hinder the relative movements that occur at this point between stack and saddle due to temperature changes, but if desired a spring may be inserted between the set screw and the lug 32, or the construction shown in Fig. 7 may be used wherein the lug is replaced by an elastic member 34.

Provision is made for conveniently dismantling the ejector by removing it piece after piece in case no suitable crane can be had. For this purpose a seat 35 is provided around the exhaust standpipe (Figs. 1 and 2): after loosening the exhaust nozzle 4, the remaining part of the ejector except the stack 1, may be lowered by loosening the bolts connecting the flanges 36 of the stack and 37 of the stack extension. Two of said bolts, of which one, 38 is visible in Fig. 2 while the second is diametrically opposed, are especially long as shown in more detail in Fig. 4. Obviously these long bolts may be used to let down the lower part of the ejector until the ring 7 of the basket comes to rest upon the seat 35 of the standpipe as indicated by the dotted lines in Fig. 2; for this purpose, the free length H of the bolts 38 is slightly greater than the distance *h* between ring 7 and seat 35. As soon as said ring is resting upon said seat, all bolts holding the ejector together may be removed and one part after the other may be lifted and carried out of the smokebox. The long bolts 38 are protected against corrosion and rust by sleeves 40 attached to the nuts 39.

The slip joint between ejector and exhaust standpipe may of course be formed in different ways without departing from the spirit of my invention. Fig. 8 shows a modification wherein the joint is somewhat simplified. The exhaust nozzle 4 has no downward extension and its flange 41 is situated at its lower end as in the conventional design of such exhaust nozzles. Corresponding parts are identified by the same numerals as in the previous description and the drawings are self-explanatory. However, I prefer the earlier embodiment as providing a tighter joint and shorter arms 9 for the basket.

It is often desirable to dispense with the exhaust standpipe. Fig. 9 shows the lower end of an ejector according to my invention, wherein the exhaust nozzle 4 reaches down into the suitably formed exhaust passage 42 of the cylinder saddle casting 43. In this construction, the exhaust nozzle serves to hold the ejector in position, and the conical surface 44 facilitates the application of said exhaust nozzle by automatically forcing the ejector in its proper central position as the nuts 45 are being tightened. A packing ring 46 is preferably inserted between exhaust nozzle and exhaust passage.

My invention can also be applied with advantage to locomotive draft appliances of other than circular (oblong) cross-section, of which a preferred embodiment is illustrated by Figures 10 to 13. Referring first to Figures 10 and 11: Corresponding parts are designated by the same numerals as in Figures 1 and 2. The intermediate nozzle is omitted but may be incorporated of course if so desired. No bolts or screws are shown as their application may be made analogous to Figs. 1 and 2 and is self-evident in connection with the previous description. The set screws 31 in Fig. 2 need not be applied here as this ejector cannot turn around its axis due to the oblong slip joint at the exhaust pipe holding it. While said slip joint is exactly analogous to the circular joint of the cylindrical ejector shown in Fig. 1, the seat on the saddle is of different construction as will now be described: The flange 17 of the stack 1 is fitted with a completely flat, horizontal bearing surface 42 by means of which the ejector is resting on the corresponding flat seat of the auxiliary saddle 43. Said auxiliary saddle, at its lower end is fitted with a bearing surface 44 forming part of a hypothetical cylinder 44*a* (Fig. 11) with an axis 45 and a radius 46; said axis 45 is situated horizontally in the longitudinal central plane of the ejector. A transverse section through the auxiliary saddle 43 is shown in Fig. 13. Naturally, the flat bearing surface 42 between stack and auxiliary saddle would not prevent the stack from shifting sideways on said saddle: therefore I provide four ribs 47 as clearly shown in Fig. 12 representing a horizontal section through the stack; looking down at the auxiliary saddle. These ribs permit only a slight relative turning movement of the stack 1 against the auxiliary saddle 43 around the central axis 48, as indicated by the arrows 49—50.

As in case of the circular ejector hereinbefore described, the arrangement shown in Figures 10 to 13 permits, within reasonable limits, a universal movement of the stack saddle 16 against the exhaust standpipe 25 while securing tight connections between these parts and the ejector without setting up any internal stresses in the latter: the clearance between the lower ring 7 of the basket 5 (Fig. 10) and the rim 27 of the exhaust standpipe acts as a universal joint between ejector and standpipe. Any longitudinal displacement of the standpipe according to the arrows 51 will be taken care of by a corresponding longitudinal shifting of the auxiliary saddle 43 relative to its seat on the saddle 16, as far as the width of the bearing surface 44 and the clearances 52 will permit. Any necessary lateral movement following the arrows 53 in Fig. 11 is made possible by the cylindrical bearing surface 44 between auxiliary and main saddle and finally, any twisting of the exhaust standpipe relative to the saddles will cause the ejector to adjust itself around axis 48 in Fig. 12.

Thus, the application of an oblong draft appliance which is otherwise a very delicate matter requiring an accuracy not usually obtainable in this kind of work becomes very easy and convenient and requires no special care nor skill. The saddle 16 and the exhaust standpipe 25 need only be mounted approximately in place, upon which the ejector, accurately manufactured by

specialists, is simply inserted and adjusts itself automatically.

In the examples hereinbefore described I have arranged my ejector in such a way as to hang down from its seat at the top of the smokebox. This arrangement can be reversed: the weight of the ejector may be taken up by the lower or steam connection and the slip joint may be provided at the upper or gas connection. Figures 14 and 15 illustrate an embodiment of this form of construction in a draft appliance of circular cross section. Stack **54**, stack extension **55**, exhaust nozzle **56** and basket **57** form the ejector, and the lower ring **58** of the basket takes the place of the standpipe. At its bottom, ring **58** is formed as a bearing surface **59** constituting part of a hypothetical sphere **59***a* and resting on a corresponding seat on the supporting casting **60**; the characteristics of this seat need not be reiterated in view of the description given in connection with Fig. 1. The slip joint around the stack **54** is easily understood without further description. The clearance between the saddle **61** and the flange **62** of the stack may obviously be kept very small in this design. Like in the previously described examples, the completely assembled ejector may be inserted into the smokebox by a crane. In the absence of a crane, it may sometimes be desired to remove from the smokebox only the parts below the stack **54**; for this purpose, lugs **63** are provided on the stack (Fig. 15) permitting the same to be lifted by screws **64**. Thus, the stack extension and the basket **57** are being relieved from the weight of the stack and may be removed from the smokebox. A flange **65** at the lower end of the ring **58** prevents the basket from falling sideways as the stack is being lifted. Naturally, this construction may also be used with the ejector resting on a conventional standpipe instead of directly on the casting **60**. It may also be adapted to oblong draft appliances but it is obviously less suited for such.

My invention may be used to great advantage in locomotives having multiple smokestacks and exhaust nozzles, or a single smokestack and multiple nozzle openings.

My ejector may be placed in an inclined position instead of vertically, which is a sometimes very valuable feature not inherent to conventional draft appliances because in the latter any deviation from the vertical arrangement makes it still more difficult to check and maintain approximate alignment.

Any number of intermediate nozzles may be incorporated in my invention, and my ejector may be composed of any number of parts suitably fastened together or it may be cast in one piece where this should appear desirable.

Naturally, my ejector draft appliance may be combined with any of the usual nettings and deflector plates within the smokebox.

While I have shown a conventional smokebox in the form of a cylindrical chamber at the front end of a locomotive boiler, my ejector may be applied to any other construction of smokebox, like for example to the smokeboxes of rectangular cross-section in some modern high-pressure locomotives.

The flexible joints serving to connect my ejector with the adjoining parts of the locomotive I have described as various combinations of self-adjusting seats and slip joints constituting preferred examples. It is understood, however, that elastic connecting members, such as for example, a piece of corrugated flexible pipe, may be substituted as mechanical equivalents serving the same purpose, namely, of flexibly connecting two adjoining parts.

Having thus described the nature of my invention and some preferred examples to which I do not want to limit myself, I claim:

1. In a locomotive boiler, a smokebox and a draft appliance, said draft appliance forming a self-contained structure including an exhaust nozzle and a stack, and means for flexibly holding the said draft appliance within said smokebox at at least two points spaced from each other in the direction of the flow through the draft appliance; whereby the said smokebox may expand or contract or deform within all practical limits without affecting the application or action of the said draft appliance.

2. In a locomotive boiler, a smokebox, a self-contained draft appliance situated partly within and emerging from said smokebox, a steam passage leading into said smokebox and conveying steam to said draft appliance, a flexible joint between said steam passage and the draft appliance, and another flexible joint between smokebox and draft appliance at the point where the said draft appliance emerges from said smokebox.

3. The combination claimed in claim 2, characterized by the fact that, by means of a spherical bearing surface, the draft appliance is resting upon one of the said two flexible joints, while the other is a so-called slip joint permitting axial movement of the adjoining parts relative to each other.

4. In a locomotive boiler, a smokebox, a self-contained draft appliance flexibly held within said smokebox and discharging the combustion gases through an opening in the same, said opening being normally closed by a flexible joint between said smokebox and the stack of said draft appliance and being large enough to permit the draft appliance to be pulled through in its entirety.

5. In a locomotive boiler, a smokebox, an exhaust standpipe in said smokebox, a self-contained draft appliance, an exhaust nozzle forming part of said draft appliance and held in fixed relation thereto by a ring, said ring sliding over the said standpipe with sufficient play so as to provide a flexible slip joint between the same and the draft appliance, and a downward extension on said exhaust nozzle reaching down inside of the said standpipe.

6. The combination claimed in claim 5, characterized by the fact that the radial play between the outside of the standpipe and the said ring sliding over it is smaller than the radial play between the inside of the standpipe and the downward extension of the exhaust nozzle.

7. In a locomotive boiler, a smokebox, a self-contained draft appliance, said draft appliance consisting of an upper part or stack supported on said smokebox, and of a lower part divided into two or more units; a seat for the said lower part in fixed relation to the smokebox; and long bolts connecting the lower part of the draft appliance with the upper part or stack, said bolts permitting the said lower part to be brought slowly down on the said seat for the purpose of dismantling.

8. In a locomotive boiler, a smokebox, a self-contained draft appliance of oblong cross-section, a saddle on said smokebox bearing a seat in the form of a fractional horizontal cylinder, an auxiliary saddle resting on said cylindrical

seat and having a flat upper bearing surface directly supporting the said self-contained draft appliance, and means of preventing the draft appliance from making against the said auxiliary saddle any other than co-axial relative movements.

9. In a locomotive, a draft appliance comprising, in a self-contained structure, a stack, an exhaust nozzle, and at least one intermediate nozzle between, said intermediate nozzle having arms for the purpose of securing the same to the adjacent upper part of the said draft appliance, and a flange at the lower end of said intermediate nozzle for the purpose of securing the same to the adjacent lower part of the draft appliance.

10. In a locomotive boiler, a smokebox, a self-contained draft appliance emerging from said smokebox, at least one set screw held by the smokebox and acting against the draft appliance, and an elastic intermediate member interposed between said set screw and said draft appliance.

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