Jan. 6, 1953 C. A. KUTCHER 2,624,503

SPARK ARRESTER FOR STEAM LOCOMOTIVES

Filed Jan. 12, 1951 2 SHEETS--SHEET 1

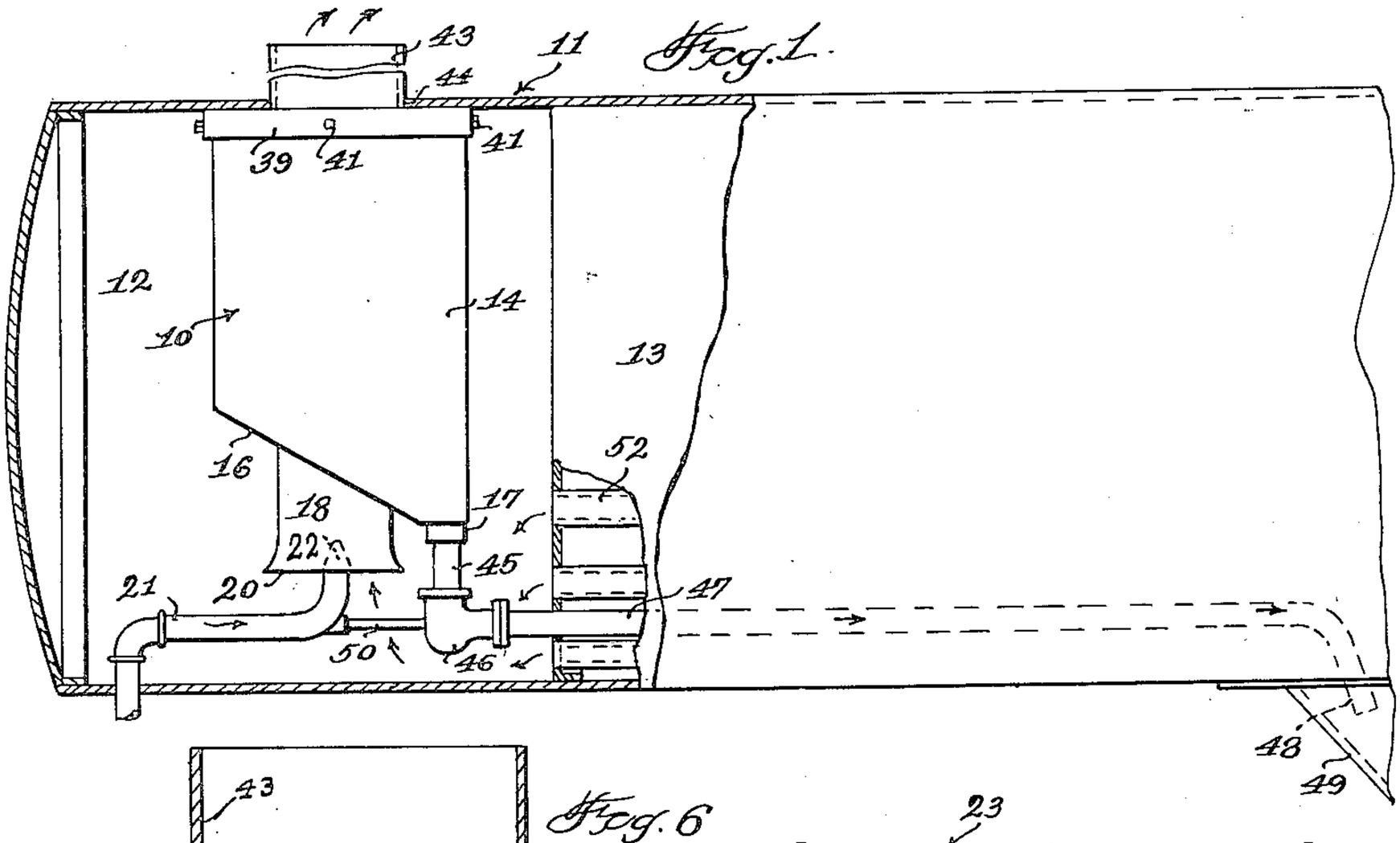

Fig. 1.

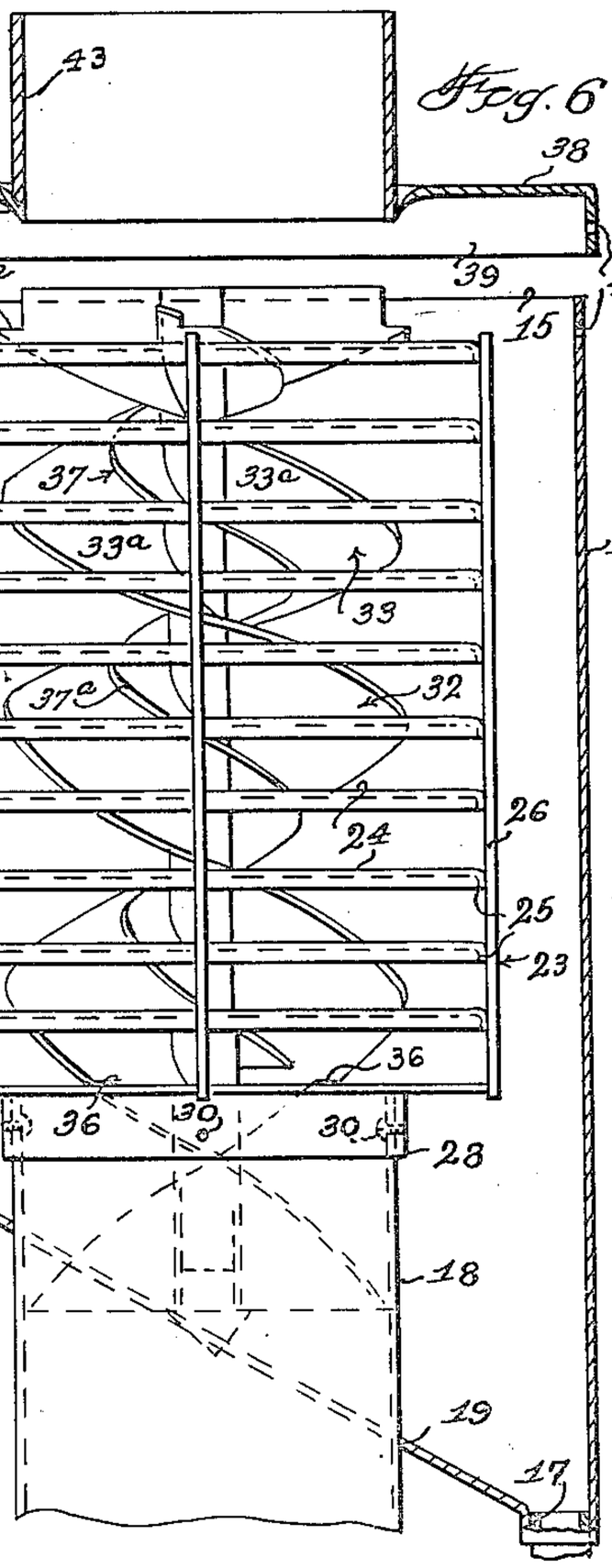

Fig. 6

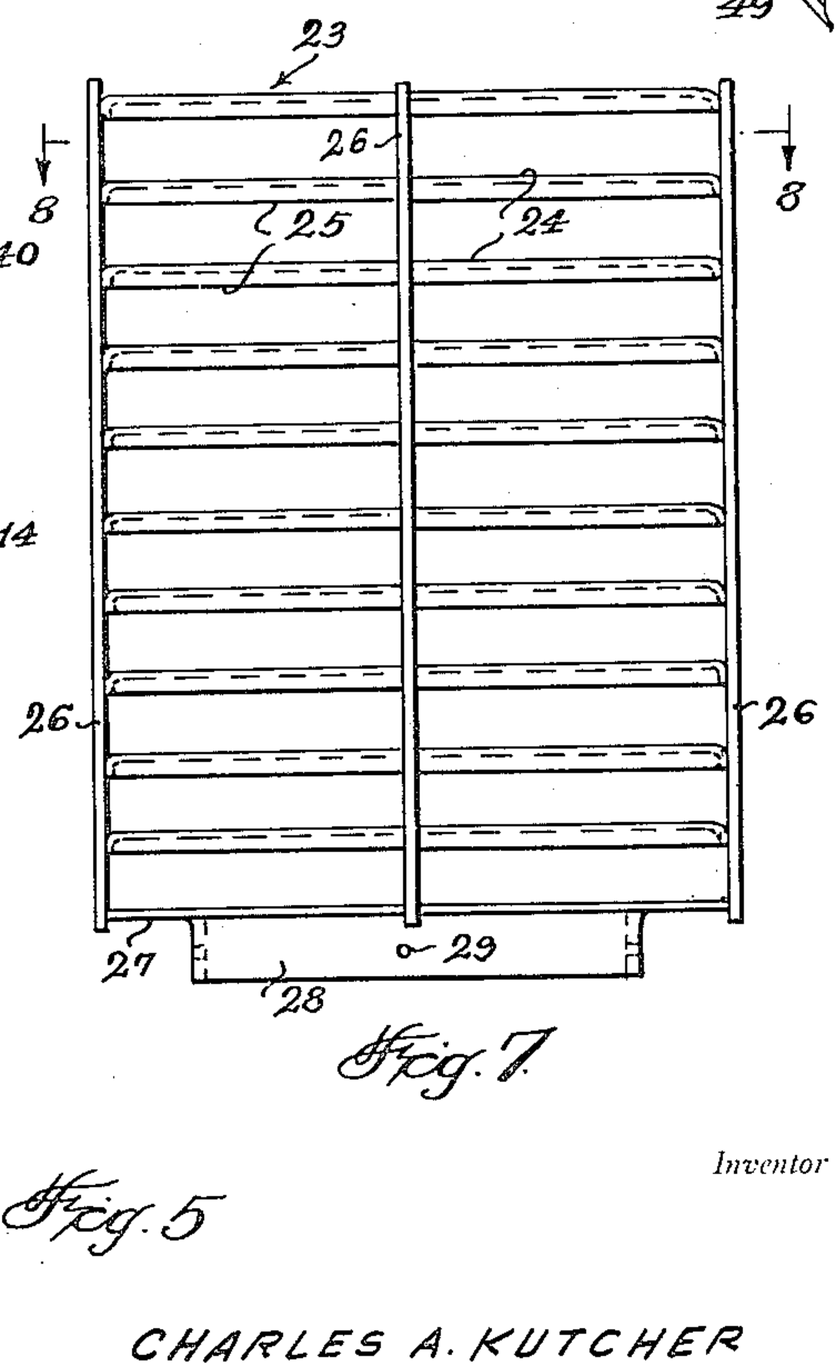

Fig. 7

Fig. 5

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Fig. 2.

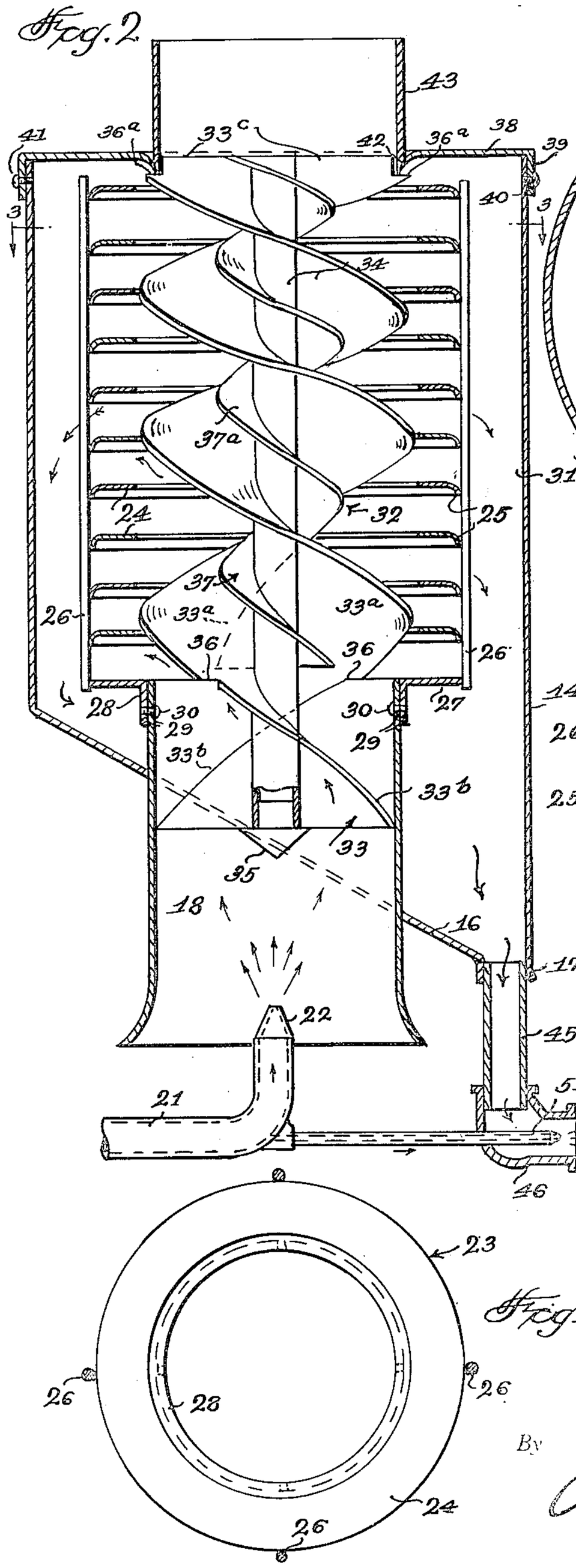

Fig. 3.

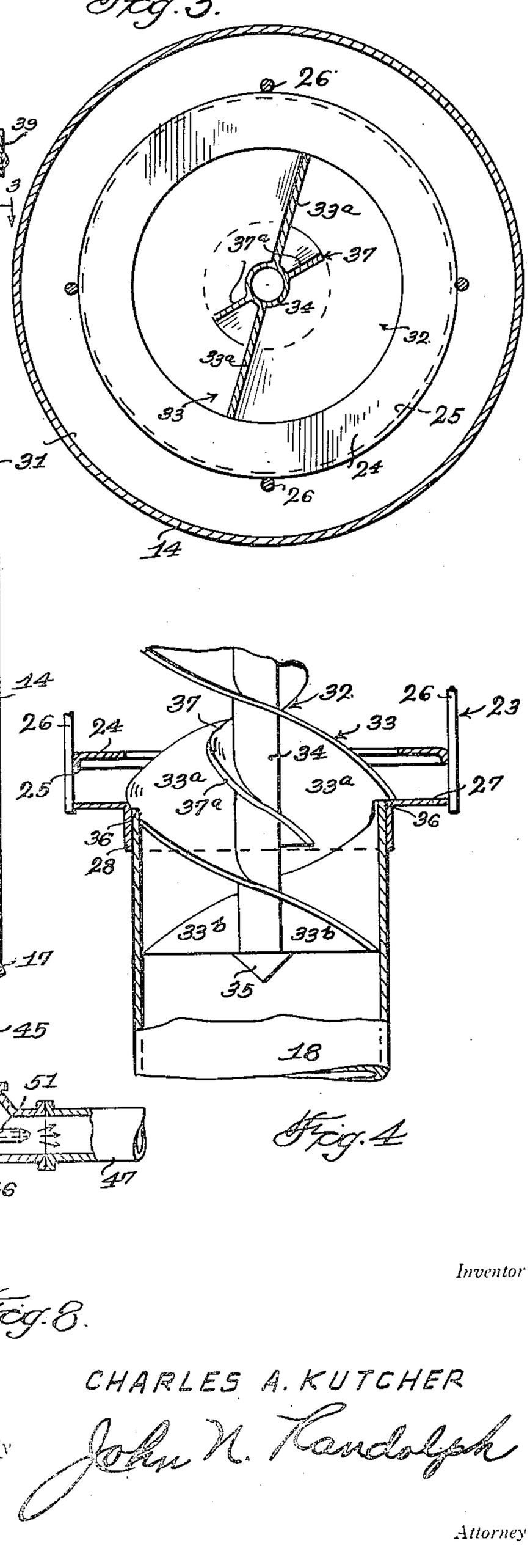

Fig. 4

Fig. 8.

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SPARK ARRESTER FOR STEAM LOCOMOTIVES

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9 Claims. (Cl. 230—97)

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This invention relates to an improved construction of spark arrester for steam locomotives which will effectively function to prevent live or burning particles of coal or cinders from being discharged from a locomotive stack without detrimentally hampering the passage of the smoke and exhaust gases to the stack.

A portion of the exhaust steam of steam driven locomotives is employed to effect a proper draft to the smoke stack from the fire box. As this steam exhaust is discharged intermittently toward the stack the surging pressure thereof creates so much suction that a considerable amount of live or burning coal and cinders are extracted from the fire box through the boiler tubes and expelled by the steam jet with the exhaust gases through the stack.

Accordingly, it is a primary object of the present invention to provide a spark arrester means between the stack and steam jet which will effectively function to remove all live particles of coal and cinders from the flue passage before it enters the stack for returning the live particles by forced draft, gravity and suction to a position from which the particles can be readily returned to the fire box or to a collecting receptacle.

A further and important object of the present invention is to provide a helical vane means of novel construction for centrifugally separating live particles of coal and cinders from the exhaust gases without materially hampering the passage of the exhaust gases to the smoke stack.

Another object of the invention is to provide a novel baffle means for receiving and deflecting the live particles away from the flue passage and downwardly to a position to be returned to the fire box or to a collecting receptacle.

A further object of the invention is to provide a helical screw means of novel construction which will effectively prevent the live particles from traveling upwardly through the flue passage adjacent the axis of the helical means and thus escaping into the stack without being subjected to sufficient centrifugal force to separate the live particles from the exhaust gases.

Another object of the invention is to provide means for receiving the live particles which will effectively function to return the particles to a position from which the particles may be returned to the fire box or deposited in a receptacle without danger of the coal and cinder particles clogging up the return means.

A further object of the invention is to provide a spark arrester composed of a relatively few parts which is capable of being readily assembled or disassembled and which will be extremely efficient and durable for accomplishing its intended result and especially adapted for use in a conventional exhaust system where the exhaust steam is employed for providing a forced draft to the stack.

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Numerous other objects and advantages of the invention will hereinafter become more fully apparent from the following description of the drawings, illustrating a presently preferred embodiment thereof, and wherein:

Figure 1 is a side elevational view, partly in vertical section, of a portion of a locomotive showing the novel spark arrester applied thereto;

Figure 2 is an enlarged central vertical sectional view, partly in side elevation of the spark arrester;

Figure 3 is a horizontal sectional view of the spark arrester taken substantially along a plane as indicated by the line 3—3 of Figure 2;

Figure 4 is a fragmentary vertical sectional view of a portion of the spark arrester taken at an angle to the plane of the section of Figure 2;

Figure 5 is an enlarged vertical sectional view, partly in side elevation of a portion of the invention;

Figure 6 is an enlarged vertical sectional view of another portion thereof;

Figure 7 is a side elevational view of the deflector unit shown removed from its supporting structure, and

Figure 8 is a horizontal sectional view thereof taken substantially along a plane as indicated by the line 8—8 of Figure 7.

Referring more specifically to the drawings, the novel spark arrester in its entirety and which constitutes the invention is designated generally 10 and is illustrated in Figure 1 in an applied position in a locomotive, a portion only of which has been illustrated. The locomotive portion, designated generally 11 includes a front chamber 12 in which the spark arrester 10 is disposed and which is disposed forwardly of the boiler 13.

The spark arrester 10 includes an outer casing 14 which is preferably cylindrical in cross section and which has an open top 15 and an inclined bottom 16. The inclined bottom 16 is provided with a restricted depending outlet 17 at its lower end. A short length of pipe or tubing 18 is secured intermediate of its ends in an opening 19 of the inclined bottom 16 in any suitable manner and is disposed substantially axially of the casing 14. The tubular conduit 18 is provided with a flared lower inlet end 20 which is dis-

posed below the casing bottom 16 and substantially above the bottom wall of the chamber 12. A steam exhaust conduit 21 extends into the chamber 12, and has an upturned discharge end which terminates in a nozzle 22. The nozzle 22 discharges into the conduit 18 adjacent its flared inlet end 20. The tubular conduit 18, constituting a part of the flue passage, and the pipe 21 having the nozzle 22 are conventional in steam driven locomotives; however, the conduit 18 functons in a unique manner with the casing 14 and other parts of the spark arrester 10, hereinafter to be described.

A deflector unit, designated generally 23 is removably disposed in the casing 14 and detachably supported on the upper end of the conduit 18. The deflector unit 23 includes a series of vertically spaced annular strips 24 which are disposed in substantially horizontal planes and in vertically spaced substantially parallel relationship to one another. The annular strips 24 which form baffles are relatively wide in a direction radially of the deflector unit 23 and are provided at their outer edges with downwardly flared peripheral portions 25. The baffles 24 are connected in vertically spaced relationship to one another by a plurality of vertically disposed rods 26 which are circumferentially spaced relatively to one another and each of which is suitably secured to a portion of the downwardly flared outer edge of each baffle member 24, as by brazing or welding. The deflector unit 23 also includes an annular base member 27 to the outer edge or periphery of which the lower ends of the rods 26 are secured. Accordingly, the baffle members 24 are supported by the rods 26 which are in turn supported by the base member 27. Said base member 27 is provided with an annular depending flange 28 at its inner edge which engages detachably around the upper end of the conduit 18. Said flange 28 and the conduit portion engaged thereby are provided with registering threaded openings 29 for receiving screw fastenings 30 for detachably securing the deflector unit upon the upper end of the conduit 18 and within the casing 14. The outer diameter of the deflector unit 23 is substantially smaller than the internal diameter of the casing 14 to provide an annular chamber 31 therebetween, for a purpose which will hereinafter become apparent. When the deflector unit 23 is in an applied position, as illustrated in Figures 2 and 5, its upper end terminates beneath and adjacent the open upper end 15 of the casing 14.

A multi-vane helicoid baffle extends through the deflector unit 23 and is detachably supported in the upper part of the conduit 18. Said baffle, designated generally 32 includes a double flight primary vane 33 the corresponding flights 33*a* of which are oppositely disposed with respect to one another and are disposed around and secured to a centrally disposed stem 34 which is preferably tubular and extends from end-to-end of the baffle 32. The lower end of the stem 34 is closed by a plug 35 that preferably has a depending conical shaped head. As seen at 33*b*, each of the vanes 33*a* is provided with a lower end portion of reduced diameter so that each vane 33*a* is provided with a downwardly facing radially extending shoulder 36. The upper ends of the vanes 33*a* are likewise provided with radially reduced portions 33*c* defining corresponding upwardly facing shoulders 36*a*. The helicoid baffle 32 also includes a double flight secondary vane 37 of substantially smaller diameter than the vane 33

the lower end of which commences above and adjacent the vane portions 33*b*. The secondary double flight vane 37 extends to the upper end of the helicoid 32 and the two flights 37*a* thereof are likewise oppositely disposed and suitably secured around the axial stem 34. The secondary double flight vane 37 is substantially smaller in diameter than the primary vane 33 and each convolution thereof has substantially the same pitch as the convolution of the vane 33 which is disposed therebeneath. The vane 37 is substantially smaller in diameter than the vane 33 but the relative diameters of the vanes as illustrated may be varied. The outer diameter of the helicoid baffle 32 is slightly smaller than the internal diameter of the deflector unit 23 as defined by the inner edges of the baffle elements 24 so that the helicoid 32 can be inserted downwardly through the deflector unit 23 after the latter has been secured to the upper end of the conduit 18, as previously described. The flight portions 33*b* of the vane 33 are sized to fit into the conduit 18 and the flight portions 33*a* are larger in diameter than the conduit 18 so that their downwardly facing shoulders 36 will rest upon portions of the upper edge of the conduit 18 and upon portions of the member 27 to support the helicoid 32 in an upright position within the deflector unit 23 and substantially axially thereof and of the casing 14.

The open upper end 15 of the casing 14 is closed by an annular cover 38 having a depending marginal flange 39 which engages around the upper portion of the cylindrical wall of the casing 14 and which is provided with openings 40 to register with openings of said cylindrical wall for receiving screw fastenings 41 by which the cover 38 is detachably secured on the upper end of the casing 14. The closure 38 is provided with a central opening defined by a downwardly flared annular flange 42 of said closure in which is suitably secured the lower end of a smoke stack 43 which extends upwardly therefrom through an opening 44 in the top wall of the chamber 12. The edge of the downwardly flared annular cover portion 42 bears upon the upwardly facing shoulders 36*a* support the helicoid 32 against upward displacement and to brace the upper end thereof against any swinging or lateral movement relatively to the casing 14.

A short length of pipe 45 is suitably secured to and extends downwardly from the casing outlet 17 and is connected at its lower end to an upwardly opening end of an elbow joint 46. A horizontally disposed conduit 47 is connected to and extends from the opposite end of the elbow joint 46 longitudinally along the boiler 13 and has an opposite discharge end 48, as seen in Figure 1, which may open into a receptacle 49 or which may discharge into the fire box, not shown, of the locomotive 11. A small tube 50 is tapped into the steam pipe 21 adjacent its upturned end and extends therefrom into the elbow joint 46 and is provided with a nozzle 51 which discharges into the elbow joint 46 toward the conduit 47, as seen in Figure 2.

When the locomotive is in operation the exhaust steam will flow through the pipe 21 in the direction as indicated by the arrow in Figure 1 in surging pressures and as the exhaust steam is discharged from the nozzle 22 it will create a suction in the inlet end 20 of the conduit 18. The exhaust gases will thus be drawn from the fire box, not shown, through the boiler tubes 52

into the chamber 12 and thence into the pipe end 20. This surging steam pressure will likewise draw burning particles of coal and cinder from the fire box through the tubes 52 which will likewise be conveyed upwardly through the conduit 13 into the casing 14. The steam jet from the nozzle 22 will create a substantial updraft through the tube 18 and casing 14. To prevent the burning particles from being blown through the casing 14 into the stack 43 the deflector unit 23 and helicoid baffle 32 are provided. The large double flight helical vane 33 will cause the exhaust gases carrying the burning particles to swirl spirally while en route between the ends of the helicoid 32 so that the heavier particles will be deflected centrifugally away from the axis of the helicoid 32 toward the annular baffle plates 24 and these burning particles will be thrown outwardly by centrifugal force between the baffle plates 24 into the annular surrounding chamber 31 of the casing 14. The downturned outer edges 25 of the annular members 24 will deflect the burning particles downwardly as they are ejected centrifugally into the chamber 31 and a small percentage of the steam will also pass into the chamber 31 with these particles which together with gravity force will propel the burning particles down the inclined bottom 16 into the discharge pipe 45. Should any of the burning particles continue upwardly within the deflector 23 to above the upper deflector plate 24 thereof, such particles would be deflected radially outwardly by the annular downwardly flared closure portion 42 and will thus be directed into the chamber 31. Likewise, a small additional part of the steam pressure will be deflected under the closure 38 by its portion 42 to create a back pressure at the top of the annular chamber 31 which will prevent any of the live particles from passing upwardly in said chamber 31 and thus reaching the stack 43. The stem 34 is preferably of a diameter approximately one-fourth the diameter of the helicoid 32 and functions to prevent or minimize the tendency of burning particles to pass axially up the double vane 33. However, the secondary vane 37 additionally and primarily functions to deflect the burning particles away from the axis of the helicoid and so that said particles will be fully subjected to centrifugal force by the vane 33*a*. The steam jet from the nozzle 51 will create a suction in the pipe 45 to draw the burning particles downwardly therethrough and into a position to be blown by said steam jet through the conduit 47 into the collection receptacle 49 or back into the locomotive fire box, if the discharge 48 is located to open into the fire box.

As illustrated in the drawings, the pitch of the vanes 33 and 37 varies from end-to-end of the helicoid 32 so that the inclination of the vanes is greater nearer their bottoms than adjacent their tops. Thus, the upward movement of the exhaust gases and burning particles is increasingly resisted by the helicoid from the bottom to the top thereof and the centrifugal force exerted by the helicoid likewise increases toward its upper end so that with a minimum obstruction of the draft through the casing 14 all of the burning particles can be extracted from the exhaust gases between the conduit 18 and stack 43.

Various modifications and changes are contemplated and may obviously be restored to, without departing from the spirit or scope of the invention as hereinafter defined by the appended claims.

I claim as my invention:

1. A spark arrester comprising an upright casing having an open top and an inclined bottom, said casing having a restricted outlet at the lower end of said inclined bottom, an inlet conduit extending through and secured intermediate of its ends in said inclined bottom and supported thereby axially of the casing, a steam discharge nozzle opening upwardly into the lower inlet end of said conduit for creating an updraft through the conduit and casing, a deflector unit having an annular base portion disposed around and detachably secured to the upper end of said conduit and supported thereby within the casing and axially thereof, said deflector unit including a plurality of rods fixed to and rising from said annular base and a plurality of annular deflector plates connected to and supported by said rods in vertically spaced relationship to one another, a helicoid baffle including a double flight vane extending through said deflector unit and demountably supported therein on the upper end of said conduit, an annular closure detachably mounted on the open upper end of said casing and having a central opening disposed in alignment with said helicoid baffle, and a stack having a lower end secured in said central opening to receive the exhaust gases from said casing, said helicoid baffle functioning to deflect burning particles carried by the exhaust gases centrifugally outwardly through the spaces between the annular deflector plates to be returned by gravity downwardly through the outer part of said casing down the inclined casing bottom to said restricted outlet.

2. A spark arrester as in claim 1, said casing defining an annular chamber around the deflector unit into which the burning particles are centrifugally ejected through the deflector unit, and each of said annular deflector plates having a downwardly flared peripheral portion for deflecting the burning particles downwardly through the annular chamber of said casing.

3. A spark arrester as in claim 1, said casing defining an annular chamber around the deflector unit into which the burning particles are centrifugally ejected through the deflector unit, and each of said annular deflector plates having a downwardly flared peripheral portion for deflecting the burning particles downwardly through the annular chamber of said casing, said annular closure having a downwardly and inwardly flared annular portion defining the central opening thereof for additionally deflecting burning particles toward the annular chamber of the casing and which bears upon a portion of the helicoid baffle to combine with said conduit to support the helicoid baffle in an upright position within the casing.

4. A spark arrester as in claim 1, said double flight vane having a restricted bottom portion fitting into said conduit defining downwardly facing shoulders disposed to rest upon the upper end of the conduit to support the helicoid baffle in an upright position in the casing.

5. A spark arrester as in claim 1, said double flight vane having a restricted bottom portion fitting into said conduit and defining downwardly facing shoulders disposed to rest upon the upper end of the conduit to support the helicoid baffle in an upright position in the casing, said vane having a restricted upper end extending into the stack providing upwardly facing shoulders bearing against the closure for holding the upper end of the helicoid baffle against upward movement

or lateral movement relatively to the casing when the closure is in an applied position.

6. A spark arrester as in claim 1, said double flight vane having a restricted bottom portion fitting into said conduit defining downwardly facing shoulders disposed to rest upon the upper end of the conduit to support the helicoid baffle in an upright position in the casing, said helicoid baffle including a secondary double flight spiral vane interposed between the convolutions of the first mentioned vane of a diameter substantially less than the diameter of said first mentioned vane for deflecting burning particles away from the axis of the helicoid baffle.

7. A spark arrester as in claim 1, said double flight vane having a restricted bottom portion fitting into said conduit defining downwardly facing shoulders disposed to rest upon the upper end of the conduit to support the helicoid baffle in an upright position in the casing, said helicoid baffle including a secondary double flight spiral vane interposed between the convolutions of the first mentioned vane of a diameter substantially less than the diameter of said first mentioned vane for deflecting burning particles away from the axis of the helicoid baffle, said helicoid baffle including a centrally disposed stem extending from end-to-end thereof, and said first mentioned and secondary vanes being disposed around and secured to said stem.

8. A spark arrester as in claim 1, said double flight vane having a restricted bottom portion fitting into said conduit defining downwardly facing shoulders disposed to rest upon the upper end of the conduit to support the helicoid baffle in an upright position in the casing, the pitch of said vane diminishing from its lower end to its upper end whereby the burning particles will be subjected to increased centrifugal force as they approach the stack.

9. A spark arrester comprising a casing, a stack communicating with and rising from the casing, an inlet conduit extending into the casing beneath the stack, a steam discharge nozzle discharging into the conduit upwardly toward the stack, a helicoid baffle disposed in the casing between the inlet conduit and stack, a deflector unit mounted in the casing on the inlet conduit and around the helicoid baffle including a plurality of deflector plates each surrounding a part of the helicoid baffle, said deflector plates being spaced longitudinally of the helicoid baffle to define spaces therebetween through which burning particles carried by exhaust gases are deflected outwardly into the casing portion surrounding the deflector unit by centrifugal force from the helicoid baffle to be conveyed by gravity away from the stack.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,241,059	VanHorn	Sept. 25, 1917
1,499,437	Adams	July 1, 1924
1,990,315	Anderson	Feb. 5, 1935
1,991,703	Schellens	Feb. 19, 1935
2,009,469	Anderson et al.	July 30, 1935

FOREIGN PATENTS

Number	Country	Date
2,089	Sweden	Mar. 26, 1889