

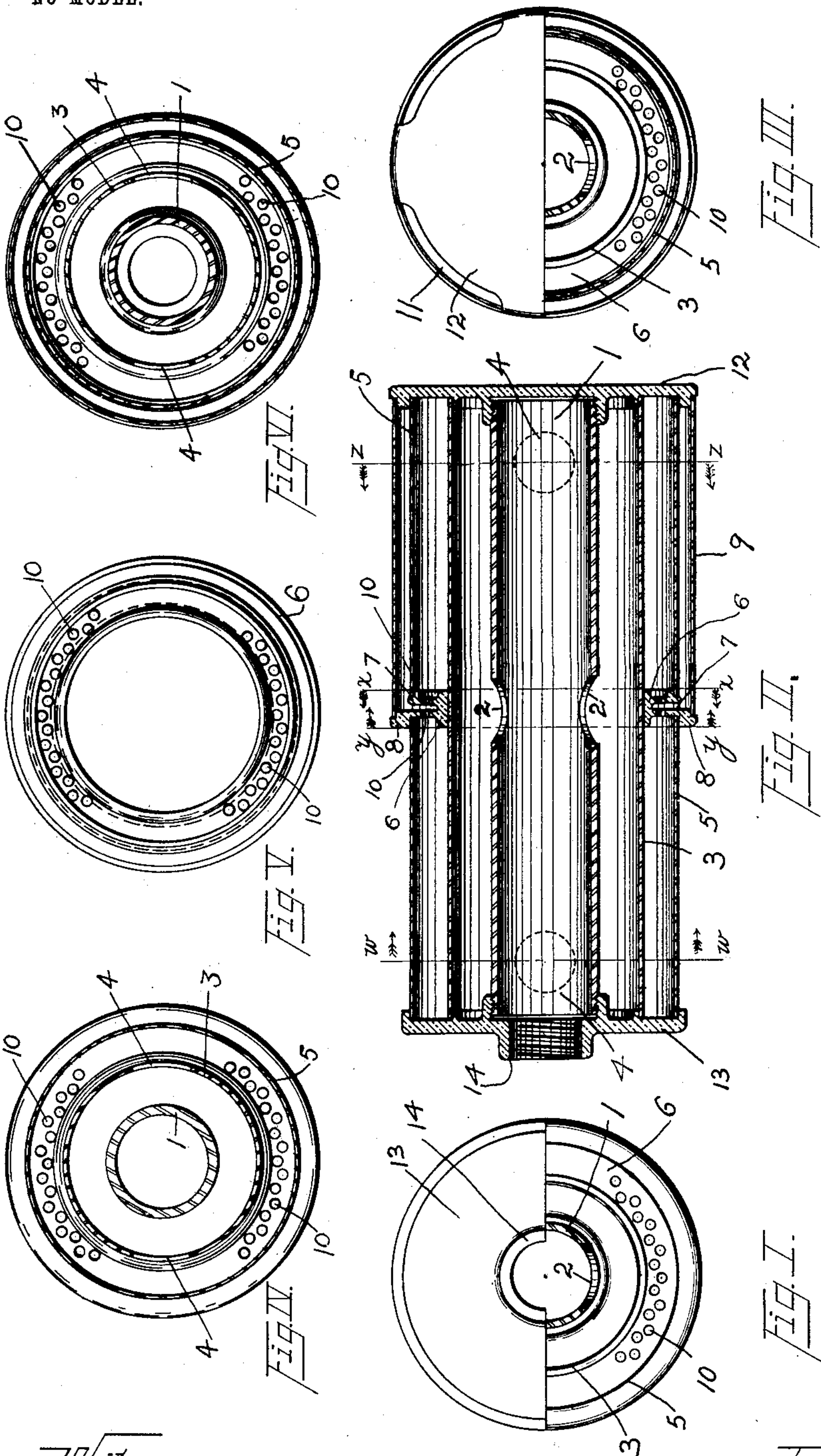
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E. L. RUSSELL.  
MUFFLER FOR HYDROCARBON ENGINES.

APPLICATION FILED MAY 4, 1903.

NO MODEL.



Witnesses:-  
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# UNITED STATES PATENT OFFICE.

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## MUFFLER FOR HYDROCARBON-ENGINES.

SPECIFICATION forming part of Letters Patent No. 749,883, dated January 19, 1904.

Application filed May 4, 1903. Serial No. 155,471. (No model.)

*To all whom it may concern:*

Be it known that I, EDWIN L. RUSSELL, a citizen of the United States, residing at Cleveland, Ohio, have invented a new and Improved Muffler for Engines, of which the following is a specification.

This invention relates to mufflers for engines, and particularly to mufflers for hydrocarbon-engines; and the object is to provide a muffler which will allow the spent gas to expand a step at a time, so graded that there will be no back pressure, and that will keep this gradual expansion going until the gas has but little more than atmospheric pressure and then divide the gas and let it escape from two different cylinders in small jets, so that the jets from the two cylinders will meet and neutralize each other.

Other objects and advantages will be fully explained in the following description, and the invention will be more particularly pointed out in the claims.

Reference is had to the accompanying drawings, which form a part of this specification.

Figure I is an end elevation with one-half of the muffler in cross-section along the line *yy* of Fig. II. Fig. II is a longitudinal section. Fig. III is an end elevation of the opposite end shown in Fig. I, with one-half in cross-section along the line *xx* of Fig. II. Fig. IV is a cross-section along the line *ww* of Fig. II. Fig. V is a side elevation of the annulus through which the gases escape to the atmosphere. Fig. VI is a cross-section along the line *zz* of Fig. II.

Similar characters of reference are used to indicate the same parts throughout the several views.

The muffler is provided with a series of concentric cylinders having a central cylinder 1 to receive the spent gas from a hydrocarbon-engine, the volume of which cylinder is larger than the engine-cylinder. This will permit some expansion of the gas. The gas is allowed to escape from opposite sides of the cylinder through the holes 2, which are substantially midway between the ends of the cylinder. These holes are so arranged as to cause the gas to cushion at the end of the cylinder op-

posite the entrance. The cross-section area of the two holes 2 together is slightly less than the cross-section area of the pipe itself in order that the gas may not pass through too freely, but cushion against the end of the cylinder and between the expansion expand to holes 2. This has the effect of straightening out the wave motion of the expansions. There will be some vibrations caused by expansion resulting from the expansions, but being inclosed the vibrations are not audible. From the center cylinder 1 the gas passes to an intermediate cylinder 3, whose volume, the volume of the circumscribing space, is larger than the volume of the cylinder 1 for the purpose of allowing some expansion of the gas. The gas will expand to some extent in the intermediate cylinder 3, which circumscribes cylinder 1, and escape through holes 4, which are substantially ninety degrees around from holes 2. There are four holes instead of two, two holes near each end of the cylinder, each hole of a pair being diametrically opposite the other, being thus arranged to allow the gas to expand to the full volume of the cylinder before leaving that cylinder.

The gas passes from the intermediate cylinder to an outer cylinder 5, which circumscribes the intermediate cylinder. The volume of the circumscribing space is larger than that of the intermediate cylinder to allow the gas to expand again. Each expansion will cause vibrations, but being inclosed they are not heard. The outer cylinder is intercepted by an annulus 6. This annulus 6 has an annular groove 7 on the outer side. The parts of the annulus opposite this groove are in the nature of flanges, one of which extends radially beyond the cylinder 5 and forms a head or an end 8 for the exit-cylinder 9, which circumscribes one end of the outer cylinder 5 and has a seat formed on the opposite side from said exit-cylinder for the circular wall of cylinder 5. The other flange of the annulus extends radially only far enough out to form a seat for the circular wall of the cylinder 5, which is inclosed by the exit-cylinder. The gas escapes from the two parts of the cylinder 5 through a series of apertures 10 in op-



posite sides of the flanges of the annulus. These apertures 10 are substantially ninety degrees around the muffler from the holes 4 in cylinder 3. The apertures 10 in each flange 5 for the escape of gas from the two parts of the cylinder are exactly opposite each other, or it may be said that the apertures in one flange register with the apertures in the other flange. The object of this arrangement is to 10 cause the jets of gas coming from one of the parts of the cylinder 5 to meet directly the jets of gas coming from the other part of cylinder 5. The gas first escapes to the atmosphere at this point. The object of having the 15 jets from the two parts of the cylinder 5 meet each other is to cause the noise which would be caused by each jet to be neutralized or deadened by the jet coming from the opposite direction. The meeting of the jets takes place 20 in the annular groove in the annulus 6. The vibrations caused by expansion of gas-jets coming from one direction meet the vibrations caused by expansion of jets coming from the opposite direction, and the two sets of vibrations thus meeting each other are neutralized or 25 destroyed without noise. The spent gas then passes out of the exit-cylinder through curved slots 11 in the cap 12. This cap closes the ends of all the other cylinders, and a cap 13, 30 having a connection 14, closes the ends of all the other cylinders.

Having fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

35 1. A muffler for hydrocarbon-engines comprising a series of concentric cylinders, heads for said cylinders, an opening through one of said heads to the central cylinder, each cylinder being perforated for the passage of gas 40 from the inner cylinder, and means mounted in the outer cylinder for causing the gas to escape in two series of jets and for causing one series of said jets to meet the other series of jets just as said jets reach the atmosphere, said means consisting of an annulus 45 having an annular groove therein exposed to the atmosphere and a series of apertures in each part of said annulus opposite said groove.

2. A muffler for hydrocarbon-engines comprising a central cylinder for receiving spent 50 gas from an engine, an intermediate cylinder whose volume is of greater capacity than the volume of said central cylinder circumscribing said central cylinder, an outer cylinder 55 whose volume is of greater capacity than the volume of said intermediate cylinder circumscribing said intermediate cylinder, passages from each of said cylinders to the other, and means for dividing the outer cylinder into two 60 parts and causing jets of gas from one part to impinge jets coming from the other part at the moment the gas reaches the atmosphere.

3. A muffler for engines comprising a series of concentric cylinders attached together, a

passage from each cylinder to the other, means 65 for dividing the outer cylinder into two parts and permitting one or more series of jets of gas from one of said parts to meet similar jets from the other part just after the jets come in contact with the atmosphere whereby the vi- 70 brations caused by the expansion of the gas are destroyed, said means consisting of an annulus having an annular groove therein exposed to the atmosphere and a series of apertures in each part of said annulus opposite 75 said groove.

4. A muffler for engines comprising a series of concentric cylinders connected together, a connection for the central cylinder with an engine, a passage from each cylinder to the 80 other, an annulus for dividing the outer cylinder into two parts, said annulus having an exterior annular groove, one or more series of perforations through said annulus whereby jets of gas will come from each of said parts 85 and meet in said groove.

5. A muffler for engines comprising a series of concentric cylinders connected together, a connection for the central cylinder with an engine, a passage from each cylinder to the 90 other, an annulus for dividing the outer cylinder into two parts, said annulus having an annular exterior groove and having one or more series of perforations through said annulus whereby gas may come from each of said 95 parts and meet in said groove, and an exit-chamber for conveying the spent gas from said groove to one end of said muffler.

6. A muffler for engines comprising a series of concentric cylinders connected together, a 100 connection for the central cylinder to an engine, a passage from each cylinder to the other, said cylinders being adapted to permit some expansion in each succeeding cylinder from the central cylinder to the outer cylinder, and an 105 annulus having an exterior groove dividing the outer cylinder in two parts, said annulus having perforations therethrough whereby one or more series of jets of gas from each of said parts will meet in said groove. 110

7. A muffler for engines having a series of cylinders concentrically arranged for permitting a series of expansions progressively therein, and means for dividing the outer cylinder 115 in two parts and for permitting one or more jets of gas from one of said parts to meet directly similar jets of gas from the other part just after the gas comes in contact with the atmosphere, said means consisting of an annulus having an annular groove therein exposed to 120 the atmosphere and a series of apertures in each part of said annulus opposite said groove.

8. A muffler for engines having a series of cylinders concentrically arranged for permitting a series of expansions progressively therein, means for dividing the outer cylinder in 125 two parts, and for causing one or more series of jets of gas from one of said parts to meet

directly similar jets of gas from the other  
part, said means consisting of an annulus hav-  
ing an annular groove therein exposed to the  
atmosphere and a series of apertures in each  
5 part of said annulus opposite said groove, and  
an exit-cylinder for conveying spent gas to  
one end of said muffler and discharging the  
same.

In testimony whereof I set my hand, in the  
presence of two witnesses, this 2d day of May, 10  
1903.

EDWIN L. RUSSELL.

Witnesses:

E. J. THOBABEN,  
ALBERT FOYER.