My invention relates to improvements in mixing devices, more particularly to fuel mixing devices for oil burners.

It has been found that if the ordinary form of oil burner is adjusted to obtain the proper air and oil mixture for the best combustion during normal operation, there is a liability of the mixture failing to ignite when the equipment is started cold. If the equipment is so adjusted that when started cold the proper mixture of oil and air is supplied to insure combustion, then at other times the burner is not operating at best efficiency. Another difficulty prevailing in many oil burners is the after-fire which causes smoke when the burner is shut down. This is due to the fact that the blower and oil pump are shut down simultaneously and the oil in suspension is provided with insufficient combustion air for total combustion.

Hence it is a principal object of my invention to provide an oil burner with automatic means for varying the fuel mixture so as to provide a rich fuel mixture upon starting to insure ignition and thereafter reduce the richness of the mixture to obtain increased efficiency after combustion has been established.

It is another object of my invention to insure complete combustion in the oil burner when shutting down the oil burner.

A still further object of my invention is to provide a variable flame oil burner while maintaining the proportions of oil and air constant for maximum efficiency under limits.

Briefly, one form of my invention for controlling combustion in an oil burner consists of a differential drive for the oil pump and the air blower. The air blower has attached thereto a flywheel so that an appreciable torque is required to start it before full blower speed is attained. The oil pump on the other hand due to its low moment of inertia tends to attain more than normal speed on starting so that the amount of oil supplied to the air will cause a rich mixture which is easily ignited. As the inertia of the flywheel is gradually overcome by the differential drive the blower will rotate faster and the pump will slow down. A balance will result so that the proper proportions of oil and air are supplied to the oil burner furnace for best efficiency.

By adjusting a control valve the amount of oil pumped by the oil pump can be decreased. This decreased load on the pump results in an increase in the pump speed. But as the pump speed increases the blower speed, due to the differential drive, decreases. Thus both the oil and air are decreased in such proportions as to maintain a constant ratio between the two between wide limits. A variable flame is thereby provided having a very high combustion efficiency.

The drawing represents one embodiment of my invention.

In the drawing, the oil burner furnace has mounted therein the firepot 11. A blower 12 and an oil pump 14 furnish air and oil to the firepot 11, the oil being pumped through the conduit 14 and being mixed with the air from the blower 12 in the mixing chamber 13.

The driving motor for driving the blower 12 and the oil pump 14 is a type of induction motor in which both the rotor and the frame rotate. The frame 15 which carries the squirrel cage windings 16' rotates in the bearings 21 and 22 and the rotor 16 which carries the field windings rotates in the bearings carried by the frame 15. It is of course understood that the field windings could be carried by the frame instead of by the rotor and that the squirrel cage could be placed on the rotor. Energy is supplied to the rotor 16 of the driving motor through the electrical supply conductors 23 and 24. The inner slip rings 16 connected to the field windings are electrically connected to rings 23' and 24' by suitable brushes 16. The rotor 16 also carries a split phase winding for starting which is opened by centrifugal switch 20 when running speed is attained by rotor 16. The rotor 16 drives a pulley 18 which by means of the driving belt 20 drives pulley 19 attached to the oil pump 14. The frame 15 is connected to drive the blower 12 mounted on the shaft 17 which also carries the flywheel 13.

The relative speed between the rotor and
frame is slightly less than synchronous speed, which would be the speed of the rotor if the frame were held stationary, the variation from synchronous speed of course being due to the slip resulting from the torque on the motor. By adjusting the relative torque of the blower and the pump, any relative speed of the pump and blower can be obtained to provide a proper mixture for combustion.  

One method of adjusting the torque relation is to adjust the driving ratio between the pulleys 18 and 19 which pulleys of course could be readily replaced by a proper gear train.

Although any type of ignition may be used I show a gas pilot light 11' for igniting the oil and air mixture.  

When the driving motor is first energized due to the inertia of the blower 12 and flywheel 13 the blower 12 and flywheel 13 will be brought up to speed very slowly. However, the oil pump having very little inertia tends to be driven at more than its normal speed by the rotor 16. This causes the amount of oil initially furnished to the furnace to be in much greater proportion to the air than under normal running conditions, thus providing a rich mixture at starting which is certain to ignite. As the blower and flywheel accelerate and attain speed, the speed of the oil pump is correspondingly reduced so that during normal operation the blower and pump will have such relative speeds that the mixture supplied to the firebox 11 will burn at maximum efficiency.

When the driving motor is deenergized, the blower and flywheel due to their inertia will continue to furnish combustion air at the normal rate for a short time with a gradual decrease as the blower comes to rest, whereas the oil pump quickly stops and the oil supply is reduced to zero. In this way sufficient combustion air is furnished until all of the oil is consumed. Consequently there is no chance for incomplete combustion and no smoke will result therefrom.

By adjusting the valve 25 to reduce the amount of oil pumped by the pump 14, the load on the pump decreases. This causes an increase in the speed of pump since the torque thereon is decreased. This, however, will tend to reduce the speed of the blower so that the air and oil furnished to the firebox 11 will be reduced in the proper proportions to maintain maximum efficiency in combustion but providing less fuel, thereby decreasing the size of the flame. In this way a variable flame may be produced when desired.

It will thus be seen that I have provided an oil burner wherein ignition is assured and wherein maximum efficiency is obtained from combustion during normal operation. It will also be seen that within limits my oil burner may supply a variable flame while maintaining a combustion of maximum efficiency.

The embodiment of the invention illustrated and described herein has been selected for the purpose of clearly setting forth the principles involved. It will be apparent, however, that the invention is susceptible of being modified to meet the different conditions encountered in its use, and I, therefore, aim to cover by the appended claims all of the modifications within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A mixing device having means for supplying one element of the mixture and another means for supplying another element of the mixture, a differential means for operating both of said supply means, and means operative to cause said differential means to vary the mixture of said elements on starting.

2. A mixing device having an electric driving motor with a rotor and a rotating frame, means for supplying one element of the mixture and other means for supplying another element of the mixture, one of said means being connected to be driven by said rotor and the other of said means being connected to be driven by said frame, and means operative to cause said rotor and rotating frame to have varying speeds to vary the elements of said mixture on starting.

3. A mixing device having a driving motor with a rotor and a rotating frame, means for supplying one element of the mixture and other means for supplying another element of the mixture, one of said means being connected to be driven by said rotor and the other of said means being connected to be driven by said frame, and means associated with said rotor and rotating frame to cause said rotor and rotating frame to vary operation of said supplying means whereby a different mixture of the elements is obtained on starting from the mixture supplied during operation after starting.

4. An oil burner having a fuel pump and a blower for supplying oil and air to the combustion chamber, a driving motor having a rotor and a rotating frame, said rotor and frame being connected to drive the pump and blower to provide a mixture of oil and air and means associated with said motor for causing said rotor and rotating frame to vary operation of said blower and pump to change the ratio of said oil and air mixture on starting.

5. An oil burner having separate means for supplying liquid fuel and air for combustion, and means for differentially controlling said separate means and automatic means operative to cause said differential means to vary the mixture of fuel and air during operation of said burner.

6. An oil burner having separate means for
supplying liquid fuel and air for combustion, and automatic means including a differential drive for controlling said separate means to provide a relatively rich fuel mixture upon initiating operation of said burner and thereafter decrease the richness of the fuel mixture.

7. An oil burner having a fuel supplying means and an air supplying means, a device including a differential driving means for operating said fuel supply and air supply means, and means associated with said device for controlling the same to provide a relatively rich fuel mixture upon starting and thereafter to provide a mixture for substantially complete combustion.

8. An oil burner having a fuel supplying means and an air supply means, a differential device for operating said fuel supply and air supply means, means controlling said differential device to provide a rich fuel mixture upon starting and thereafter to provide a mixture for substantially complete combustion, said last means insuring sufficient air for substantially complete combustion of fuel upon shutting down the burner.

9. An oil burner having a fuel supply pump and a blower, an ignition device, a differential driving means, said pump and said driving means being operatively connected, said blower being connected to be driven by said driving means and means associated with said blower for increasing the inertia thereof whereby the speed of the pump is initially abnormally high to give an initial rich mixture and the speed of the blower is gradually accelerated and the speed of the pump gradually decreased to obtain a mixture for substantially complete combustion.

10. An oil burner having a fuel supply pump and an air blower, a differential driving means operatively connecting said blower and said pump to supply a mixture for substantially complete combustion during operation of said burner, inertial means associated with the blower whereby said blower is slowly brought up to running speed upon initiating operation of the burner and said fuel pump is caused to operate at more than normal running speed to provide a rich mixture, said blower continuing to rotate due to the inertial means for a sufficient length of time to insure complete combustion of any oil in suspension upon stopping operation of the burner.

11. An oil burner having a fuel supply pump and a blower, a flywheel connected with said blower, a differential driving motor having a rotating frame and rotor connected respectively to said blower and pump to drive the same, said blower and pump upon initiating operation of the burner providing a rich fuel mixture to insure ignition, and thereafter furnishing a mixture for substantially complete combustion.

12. An oil burner having a fuel supply pump and a blower, a flywheel connected with said blower, a driving motor having a rotating frame and rotor connected respectively to drive said blower and pump, said blower and pump upon initiating operation of the burner providing a rich fuel mixture to insure combustion, and thereafter furnishing a mixture for combustion of maximum efficiency, said blower upon deenergization of said driving means being maintained operative for a sufficient length of time by said flywheel to insure complete combustion of oil in suspension.

13. An oil burner having separate means for supplying liquid fuel and air for combustion, and automatic means for differentially controlling said separate means to provide a relatively rich fuel mixture upon initiating operation of said burner and thereafter decrease the richness of the fuel mixture, said means cooperating with said automatic differential means whereby the liquid fuel and air may be proportionately decreased to vary the flame while maintaining a mixture for substantially complete combustion.

14. An oil burner having a fuel supplying means and an air supplying means, a means including a differential drive for operating said fuel supply and an air supply means to provide a mixture for substantially complete combustion, and means cooperating with said differential means whereby the fuel supply and air supply may be proportionately decreased to vary the flame while maintaining said fuel and air mixture for substantially complete combustion.

15. An oil burner having a fuel supplying means and an air supplying means, a differential device for operating said fuel supply and an air supply means to provide a mixture for substantially complete combustion, and a control device for said fuel supply for varying the amount of fuel supplied by said fuel supplying means to provide a variable flame, said differential device in response to operation of said control device varying the speed of said fuel supplying means and said air supplying means to maintain said fuel and air mixture for substantially complete combustion.

16. A burner having a means for supplying one element of a combustible mixture and other means for supplying another element of the combustible mixture, means for operating said element supplying means, and other means controlling said operating means for causing one of said supplying means to initially furnish a large quantity of one element which is gradually decreased to a predetermined smaller quantity for providing a predetermined mixture and for causing the other of said supplying means to gradually increase the quantity of the other element from a small
quantity to a predetermined larger quantity for providing said predetermined mixture.

17. An oil burner having a fuel supplying means and an air supplying means, means for operating said fuel supplying means and said air supplying means to provide a combustible mixture, and other means controlling said operating means for causing said fuel supplying means to initially deliver a large quantity of fuel which is gradually decreased to a predetermined smaller quantity to provide a predetermined mixture of fuel and air and for causing said air supplying means to gradually increase the quantity of air delivered from a small quantity to a predetermined larger quantity to provide said predetermined mixture of the fuel and air.

18. A burner having a fuel pump and an air pump, means for operating said fuel and air pumps, means controlling said operating means to cause said fuel pump to initially operate at a speed greater than normal speed whereby a large quantity of fuel is delivered, the speed of said pump being gradually decreased to normal operating speed to deliver a predetermined quantity of fuel, said control means causing said driving means to gradually increase the speed of said air pump from a very slow speed to a normal speed to gradually increase the air supply from a small quantity to a predetermined larger quantity.

In witness whereof, I have hereunto set my hand.

JOHN EATON.