Sept. 6, 1932. A. H. SANCTON 1,875,934

METHOD AND APPARATUS FOR PREPARING AND FEEDING PULVERIZED FUEL

Filed Nov. 17, 1927 2 Sheets-Sheet 1

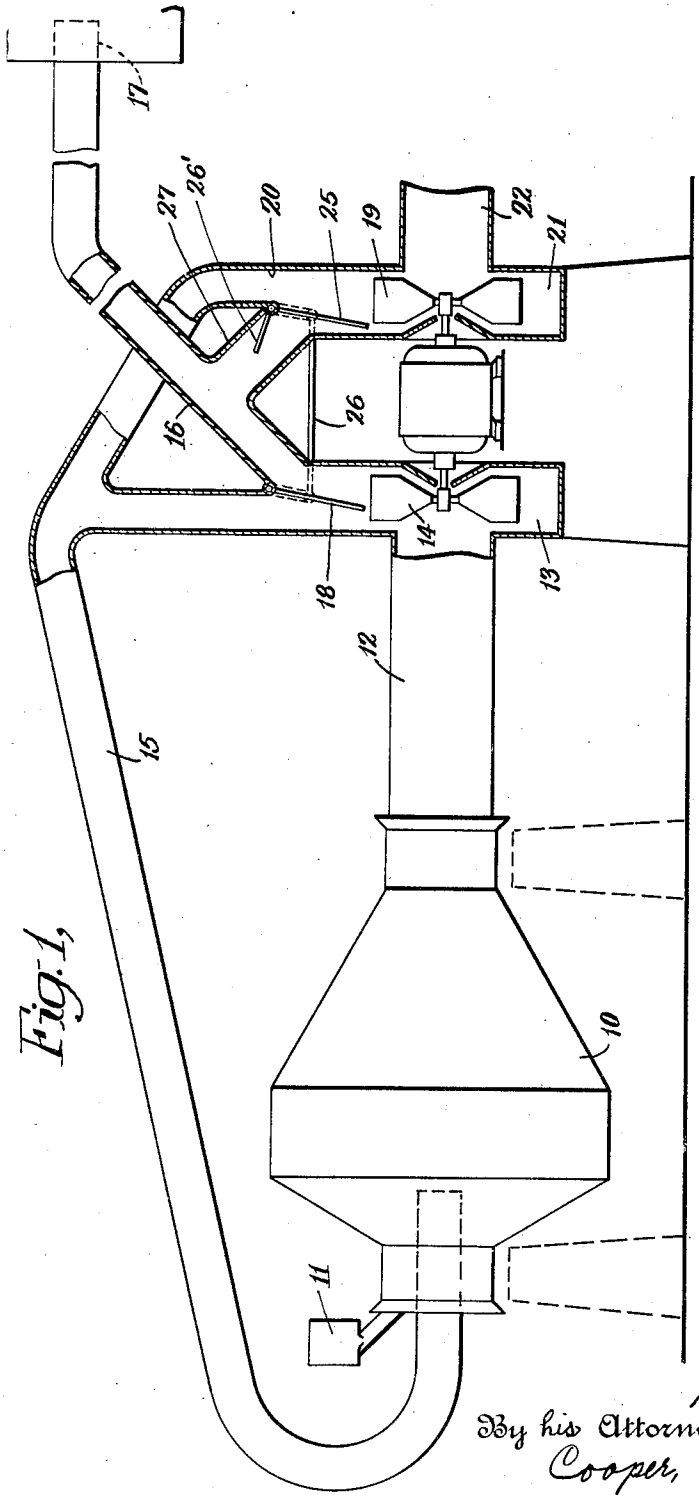


Fig. 1.

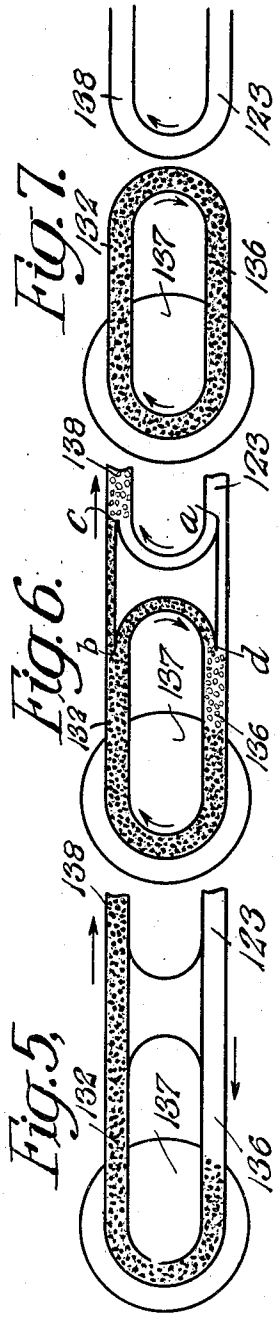


Fig. 7.

Fig. 6.

Fig. 5.

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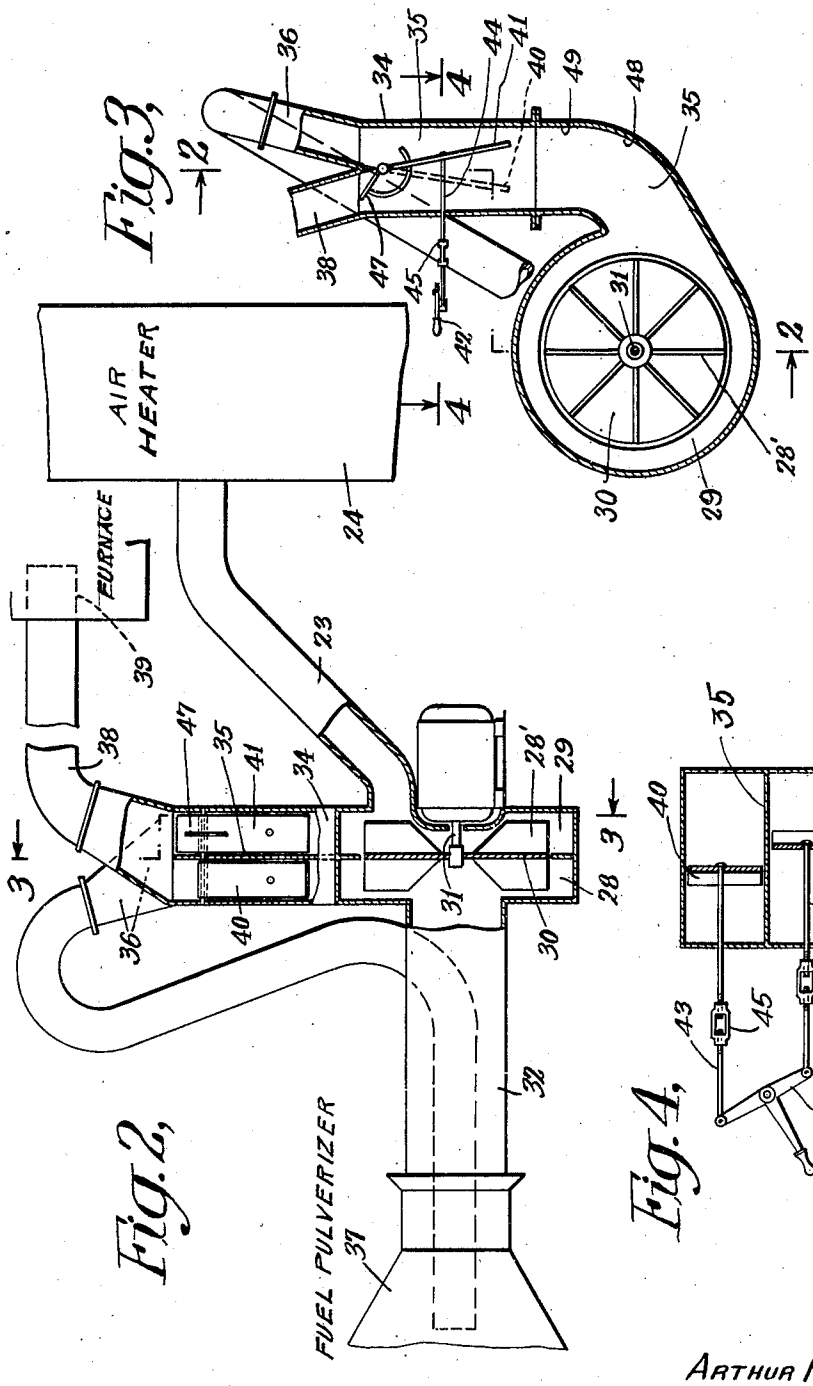


Fig. 2,

Fig. 4,

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UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR PREPARING AND FEEDING PULVERIZED FUEL

Application filed November 17, 1927. Serial No. 233,767.

This invention relates to a method and apparatus for preparing and feeding pulverized fuel to a furnace. More particularly, the invention relates to a unitary assembly including a pulverizer or disintegrating mill in which fuel such as coal is pulverized and from which the pulverized fuel is removed by a stream of fluid medium and conveyed directly to burners in a furnace. The exhauster means and the various conduits employed are so related that a continuous flow of fluid medium is maintained from the exhauster to the pulverizer and back to the exhauster. This fluid medium serves to carry the pulverized fuel from the pulverizer and, after it has passed beyond the exhauster, deflecting means divert a portion of the fluid medium to the conduit which leads to the burners.

In order to maintain the quantity of the fluid medium passing through the pulverizer substantially constant the stream of fluid medium passing through the pulverizer is replenished with fuel-free fluid such as hot or cold gases or air of a quantity substantially equal to the quantity of the fuel-laden fluid which has been diverted to the burners. In order to vary the quantity of fuel delivered to the burners the amount of fuel-laden fluid diverted thereto may be varied and it is among the objects of my invention to provide mechanism which will permit of varying of this quantity of fuel-laden fluid and automatically cause adjustment of the amount of fuel-free fluid taken into the system so that the quantity of the fluid medium passing through the pulverizer will remain substantially constant

It is a further object to provide apparatus which will permit of a quick change in the amount of fuel fed to the burners for taking care of rapid changes in the fuel requirements of a furnace or boiler without upsetting the operating characteristics of the pulverizer.

Another object resides in providing apparatus for feeding pulverized fuel to burners directly from the pulverizer without any substantial change in fineness of the pulverized fuel within wide ranges of furnace requirements in regard to fuel consumption.

Another object resides in providing such a relation of the various conduits and other parts of the apparatus as to insure that no coarse particles of fuel may be conveyed to the burners.

Other objects will be pointed out in the description of the invention and in the claims.

Referring to the accompanying drawings:—

Fig. 1 is an elevation showing apparatus in which the principle of my invention may be practiced and in which the housings and conduits are broken away to show how fluid currents are distributed.

Fig. 2 illustrates an elevation of a modified form of apparatus having conduits and housings broken away.

Fig. 3 illustrates a sectional view taken on line 3—3 of Fig. 2.

Fig. 4 is a section on line 4—4 of Fig. 3; and

Figs. 5, 6, and 7 diagrammatically illustrate the principle of fuel control under different operating conditions.

One aspect of the invention is concerned with the control of the distribution of a fuel carrying medium whereby the amount of fuel fed to burners may be regulated without causing a change in the fineness of pulverized fuel to the end that when a pulverizer is adjusted in its operation for producing a product which is capable of efficient combustion, continued attention and regulation thereof, other than for feeding of coal thereto may be of a minimum order even though the fuel demand may be suddenly varied.

In many heretofore proposed systems for feeding fuel by flotation the desirability of maintaining efficient combustion for a wide range of furnace or boiler demand has not been provided for nor are many proposed systems capable of efficiently continuing the delivery of a product for the desired combustion upon sudden demand.

In the drawings 10 designates a pulverizer which is representative of any kind of a disintegrating mill which one would desire to

use for the purpose of pulverizing coal or other fuel. The type of mill illustrated is of the well known conical type and reference may be had to the United State Patent No. 1,506,120 for a more detailed disclosure.

It is the usual practice to supply coal or other fuel to the mill by a chute 11 and, in the conical type of pulverizer, the balls or pebbles (not shown) within the pulverizer reduce the fuel to the fineness desired. It is well understood that for given conditions the fineness of the product pulverized is dependent upon the velocity or quantity of a fluid carrying medium moving therethrough. Conduit 12 is connected to the discharge end of the pulverizer and leads directly to the fan chamber 13 of an exhauster 14. This fan chamber 13 is connected to the mill by a conduit 15 through which a fluid medium may be passed from the exhauster and to the pulverizer. Another conduit 16 is likewise connected with fan chamber 13 and terminates at the burners 17. At the junction of conduits 15 and 16 there is disposed a pivoted deflector or damper 18 which may be adjusted so as to vary the proportion of fluid medium delivered by the exhauster to conduits 15 and 16. The relation of this deflector is such as to cause complementary division of the portions of fluid medium entering conduits 15 and 16 from fan chamber 13.

In order to maintain constant the quality of fluid carrying medium circulated through the pulverizer I propose to introduce into the stream of fluid medium entering the pulverizer a quantity of another fluid medium substantially equal to the quantity of fuel-laden fluid diverted by deflector 18 to the conduit 16 and burners 17. For accomplishing this result I provide a blower 19 and conduit 20 having connections with fan chamber 21 of the blower 19 and also having connections with conduit 15. Blower 19 has an inlet 22 through which fuel-free fluid is drawn. This inlet may communicate with the atmosphere directly, Fig. 1, or it may be connected by a conduit 23 with a heating chamber 24, Fig. 2, if it is desired that warm air or flue gases be used. The source of fluid medium entering at inlet 22 is immaterial to the practice of the invention, but it is desirable that this fluid medium be substantially fuel-free.

The quantity of fuel-free fluid entering conduit 20 is controlled by the position of a pivoted deflector or damper 25. With the apparatus shown in Fig. 1 if it is desired to maintain constant the flow of fluid medium through conduit 15, the quantity of fuel-free fluid introduced therein bears a direct relation with the quantity of fuel-laden fluid diverted into conduit 16. Accordingly, deflector 18 and damper 25 are connected by a rod 26 so as to maintain these two dampers always in the same relation to each other. To decrease the quantity of fuel fed to the burners through conduit 16 the damper 18 would be moved to the right with the result that the quantity of fuel-laden fluid entering conduit 15 would be increased and, because of the mechanical connection with damper 25, the quantity of fuel-free fluid entering conduit 20 would be decreased proportionately. When the deflector 18 is moved to the right, the amount of fuel carried to the burners through conduit 16 will be decreased and the amount of fuel-free fluid entering conduit 16 will be increased correspondingly within certain limits only, as will be apparent from the following description.

Dampers 18 and 25 are moved to the right when it is desired to cut down the rate of combustion at the burners and in order to further this purpose I propose to cut down the air or other fuel-free fluid entering conduit 16. For this purpose there is provided a damper 26′ pivotally mounted in conduit 27 and preferably mounted on the same pivot as damper 25 so as to swing when the position of damper 25 is being changed. The position of damper 26′ relative to damper 25 may be adjusted to suit operating conditions of the particular unit.

In Fig. 2 I have shown a modified form of my apparatus which is provided with a single exhauster 28′ having two fan chambers 28, 29 separated by disk 30 carried on the fan shaft 31. Fuel-laden fluid drawn from the pulverizer 37 through conduit 32 passes through fan chamber 28 to the left of disk 30, and fan chamber 29 to the right of disk 30 is utilized for receiving air or other fuel-free fluid taken in through inlet 23 communicating with a flue or heating chamber 24.

An open ended box 34 above the fan chambers 28, 29 is divided into two sections by wall 35 disposed in the same plane as disk 30 of the fan. The upper end of the open ended box 34 has connected therewith a conduit 36 which leads to the pulverizer 37 and a conduit 38 which leads to the burners 39. These two conduits are so connected to the open ended box as to divide its upper open end into two equal portions, a forward and a rear portion as seen in Fig. 2. At the point of junction of conduits 36, 38 there is pivoted a pair of dampers 40, 41 whose positions may be varied so that the quantity of fluid medium entering conduits 36, 38 from both fan chambers 28, 29 may be distributed as desired.

Damper 40, on the fuel-laden fluid side of wall 35 controls the distribution of fuel-laden fluid as between conduits 36, 38, and damper 41 on the fuel-free fluid side of wall 35 controls the distribution of fuel-free fluid as between conduits 36, 38. For example, when both dampers are in a medial plane the respective fluids are divided equally as diagrammatically illustrated in Fig. 6. Equal portions of the fluids are delivered to the respective conduits 36, 38, and the fluids are

then co-mingled. Referring to Fig. 6, fuel-free fluid entering the system through conduit 123 is divided equally at *a* and fuel-laden fluid leaving pulverizer 137 by way of conduit 132 is divided equally at *b*, half portions of each of the fluids are co-mingled at *c* as they enter conduit 138 to be fed to the furnace, and the other half portions of the fluids are co-mingled at *d* as they enter conduit 136 to be passed through the mill. For obtaining a maximum delivery of fuel to the furnace, damper 41 is in a far left hand position, as viewed in Fig. 3, and damper 40 is in a far right hand position. With this setting of the dampers all of the fuel-laden fluid is diverted into conduit 38 and all of the fuel-free fluid is diverted into conduit 36. This condition is diagrammatically illustrated in Fig. 5 which shows that all of the fuel-free fluid taken in from outside of the system is caused to pass through the pulverizer and then to the burners as fuel-laden fluid. Referring to Fig. 5, the fuel-free fluid entering the system through conduit 123 enters conduit 136 and is passed through the mill 137 where pulverized fuel is picked up. The fuel-laden fluid leaves the mill 137 through conduit 132 and is directed to the furnace through conduit 138.

When the burners are not functioning, damper 41 is in a far right hand position, as seen in Fig. 3 and damper 40 is in a far left hand position. The existing condition is diagrammatically illustrated in Fig. 7 which shows that all of the fuel-laden fluid is recirculated through the pulverizer and that all of the fuel-free fluid is passed to the burners. Referring to Fig. 7, the fuel-free fluid entering the system through conduit 123 is directed to the furnace through conduit 138 and a closed circulation to the fuel laden fluid is maintained through mill 137 and conduits 132 and 136.

It is apparent that when damper 40 is moved to the left (right) of a medial line, Fig. 3 the portion of fuel-laden fluid diverted through conduit 36 to the pulverizer is increased (decreased) and the portion of fuel-laden fluid diverted through conduit 38 is correspondingly decreased (increased); and that when damper 41 is moved to the right (left) of a medial line the portion of fuel-free fluid diverted through conduit 36 to the pulverizer is decreased (increased) and the portion of fuel-free fluid diverted through conduit 38 to the burners is correspondingly increased (decreased). The result is that as far as the dampers 40, 41 are concerned, damper 40 divides the fuel-laden fluid between conduits 36, 38 in portions which bear an inverse relation to each other and damper 41 divides the fuel-free fluid between conduits 36, 38 in portions which bear an inverse relation to each other; and the preferable adjusted positions of these dampers are such that the portions of fuel-laden fluid and of fuel-free fluid entering either conduit 36 or conduit 38 are complementary to each other.

In order to maintain the dampers in definite relation to one another I provide a pivoted lever 42 having equal arms, one of which is connected to a rod 43 connected with damper 40 and the other of which is connected to a rod 44 which is connected to damper 41. Turn buckles 45, 46 are provided, one for each rod so that the lengths of the rods may be varied or the rods may be entirely disconnected from lever 42 so that it may be possible to position the dampers 40, 41 independently of each other.

As in the modification disclosed in Fig. 1, a damper 47 may be provided for the purpose of cutting down the feed of fuel-free fluid to the burners when the burners are operating at a low rating. Since the utility of this damper is dependent upon the position of damper 41, it may be mounted as shown upon the same pivot as damper 41 and so connected to damper 41 as to move therewith.

I intend that the conduit returning fuel-laden fluid to the pulverizer be connected with the outlet of the exhauster housing at such a portion thereof that the centrifugal force developed by the exhauster will assist in segregating the coarse particles of fuel impelled by the exhauster. In Fig. 3 conduit 36 leading to the pulverizer is shown as being connected to the open ended box 34 at the outer side of the exhauster housing so that the coarser particles of fuel carried out of the pulverizer, and which are too coarse for efficient combustion, may be carried back to the pulverizer. Particles of fuel sufficiently large to overcome the carrying effort of the fuel-laden fluid exhausted from fan chamber 28 will seek the peripheral surface of the fan chamber, will follow the inner surface of the bulge portion 48 of conduit 49 connected with the open end box 34 and will be taken up into conduit 36 and returned to the pulverizer.

While I have disclosed my invention as a particular method and apparatus I wish it to be understood that it is adaptable for use in other fields without involving departure from the principle of the invention. For example, the apparatus is one which permits of an infinite number of settings between the extreme settings diagrammatically illustrated in Figs. 5 and 7 whereby an infinite number of proportions of different fluid mediums may be accurately co-mingled. Accordingly, should one desire to mix two pulverized materials, different streams of elastic fluid carrying known quantities of the pulverized materials could be directed into respective fan chambers and the co-mingled product obtained could be controlled as to the proportions of the respective ingredients co-mingled by

means of the dampers associated with the fan chambers.

I claim:

1. The method of preparing pulverized fuel and of feeding the same to burners comprising, pulverizing the fuel, carrying pulverized fuel from a pulverizer by means of fluid currents, diverting one portion of the fuel-laden fluid to the burners and diverting another portion of the fuel-laden fluid back to the pulverizer, co-mingling with the first named diverted portion of fuel-laden fluid a portion of fuel-free fluid substantially equal to the second named portion of the diverted fuel-laden fluid, co-mingling with the second named diverted portion of the fuel-laden fluid, a portion of fuel-free fluid substantially equal to the portion of the first named diverted portion of fuel laden fluid, and passing the last named co-mingled medium through the pulverizer.

2. In an apparatus of the class described, the combination comprising, a pulverizer, an exhauster having a chamber connected by a conduit with the discharge end of said pulverizer and by a second conduit with the charging end of said pulverizer whereby a stream of fluid medium may be passed into and removed from said pulverizer, a burner, a conduit directly connecting the chamber of said exhauster with said burner, means for diverting some of the fluid medium withdrawn from said pulverizer into said last named conduit for delivery to said burner, and means for introducing fuel-free fluid into said second conduit in a quantity substantially equal to the quantity of fluid medium diverted to said burner whereby the stream of fluid medium passing through the pulverizer is maintained substantially constant.

3. In an apparatus of the class described, the combination comprising, a pulverizer, an exhauster having a chamber connected by a conduit with the discharge end of said pulverizer and by a second conduit with the charging end of said pulverizer whereby a stream of fluid medium may be passed into and removed from said pulverizer, a burner, a conduit connecting the chamber of said exhauster with said burner, means for diverting some of the fluid medium withdrawn from said pulverizer into said last named conduit for delivery to said burner, a blower, having a chamber connected to a source of fuel-free fluid and by a pair of conduits respectively with said second conduit and said conduit connecting the burner with the exhauster chamber, and means for controlling the amount of fuel-free fluid passing respectively through said pair of conduits whereby the stream of fluid medium passing through the pulverizer is maintained substantially constant.

4. The combination with a pulverizer, of an exhauster, a conduit connecting the chamber of said exhauster with the discharge end of said pulverizer and adapted to convey fuel-laden fluid from said pulverizer, a second conduit connecting the exhauster chamber with the charging end of said pulverizer, burners, a conduit connecting said exhauster chamber with said burners, a single means for controlling communication through said second conduit and said burner conduit whereby a portion of the fuel-laden fluid can be diverted to said second conduit for return to the pulverizer, a blower, having a chamber connected to a source of fuel-free fluid and by a pair of conduits respectively with said second conduit and said burner conduit whereby fuel-free fluid can be co-mingled with the fuel-laden fluid from said pulverizer, and a single means for controlling communication through said pair of blower conduits whereby the stream of fluid medium passing through the pulverizer is maintained substantially constant.

5. The combination with a pulverizer, of an exhauster, a conduit connecting the chamber of said exhauster with the discharge end of said pulverizer and adapted to convey fuel-laden fluid from said pulverizer, a second conduit connecting the exhauster chamber with the charging end of said pulverizer and adapted to convey fuel-laden fluid back to said pulverizer, burners, a conduit connecting said exhauster chamber with said burners, a damper for controlling communication through said second conduit and said burner conduit, a blower, having a chamber connected to a source of fuel-free fluid and by a pair of conduits respectively with said second conduit and said burner conduit, a damper for controlling communication through said pair of blower conduits, and a single means for simultaneously operating both of said dampers.

In testimony whereof I hereto affix my signature.

ARTHUR H. SANCTON.