First, the "Z" pipe which conducts the gases from the producer shell to the wet scrubber would frequently become clogged with dry soot, and we found that on account of the bends in the pipe this soot would bake in hard clinkers, thus reducing and eventually choking the pipe. This pipe was replaced by a horizontal pipe extending between the producer shells and the wet scrubber, and a partition was run vertically in the wet scrubber, thus making a downtake which opened directly into the bottom of the wet scrubber.

Second, we found that tar was accumulating in the bottom of the wet scrubber and was very difficult to remove. The metal bottom was replaced by a water seal, extending all over the bottom of the wet scrubber. All other pipes where the gases have a downward trend and a sharp bend were similarly provided with water seals, in order that the tar might readily drop out and wash out, thus facilitating the cleansing of the producer.

While these water seals or water bottoms are essential to the cleansing of the plant, the following little experience will show that they must be used with some judgment. The wet scrubber as installed by Woods & Co. in the ordinary sized machine is about 5 ft. in diameter. The metal bottom of this scrubber was removed, as I have just stated, and a water seal substituted, which proved to be just the thing for a pressure producer. However, I was called upon some months later to go to a plant in Mississippi where they were having trouble with their producer. Upon my arrival I was surprised to see how nicely the producer was working, and noticed that the installation consisted of 140 h.p. engine together with a corresponding size producer of the suction type. In spite of no apparent difficulty, everybody seemed to be afraid to approach this producer, and the superintendent told me to wait awhile and see what would happen. I did wait awhile and noticed that the engine was drawing gas under a head of about 3 in. of water and this was gradually increasing until some hours afterwards it reached 5 in., and then ran rapidly to 10 in. Then there was a terrific explosion which blew through the seal and blew the poke hole castings and the plugs from the top of the producer. The negro stoker happened to be on top handling a wheelbarrow of coal, and he must have been a new hand or a nervous one, as the last I saw of him was that he was tumbling toward the ground with the wheelbarrow of coal, a distance of about 15 ft., and I noted particularly that he landed on his feet and ran down the hill-side. The only reason that I did not leave was that I was penned in by a guard rail. The after-effect of this explosion was that the remaining water seal was alternately drawn in and expelled by numerous puffs that followed. It was apparent to me at once that what had really happened was that the engine had drawn up the water from the seal and admitted a large influx of air, which no doubt made the proper mixture for causing an explosion. The remedy applied was very simple. The opening on the water seal under the scrubber was restricted in size so that no great quantity of water could be drawn in suddenly. The plant ran along afterwards without any trouble whatever, with simply working the beds and removing the clinker when the draft became obstructed. You will pardon this digression.

On account of these various troubles and because of the increase in heating value of producing gases made with barrel staves referred to before, I was prompted to try sawmill refuse in the producers, and found very much to my satisfaction that we were able to operate the plant continuously on about 130 to 135 B.t.u. gas, and the plant was more reliable on account of the even quality of gas. After about a month of use of this refuse fuel our tar troubles began to disappear, and now after using this fuel for a couple of years it is a very rare occurrence to have an inlet valve or an exhaust valve stick in the engines on account of tar, or carbon deposits. In fact, we have discarded the dry scrubber altogether and we even operated one week without a tar extractor at all, on account of that machine needing repair. This illustrates how well the sawmill refuse has solved the problem in our case when it is recalled that we could not run even five hours on coal without removing the tar.

The refuse that we use is known as "cypress hog." It consists of about 50 per cent. of sawdust and 50 per cent. of chips, such as are discharged from the "hog," which is a machine used by sawmills to destroy their refuse. This material runs from 30 to 55 per cent. moisture, and this moisture seems to be necessary for best working conditions.

I will state that we have to guard against the sawdust blowing over into the pipes which conduct the gases to the wet scrubber. This is a probably local trouble, due, no doubt, to the strength of the blast that we use in order to get capacity. We have been able to realize full capacity using sawmill refuse, and our engines deliver a brake horse-power on about 4½ lb. of this fuel.

The changes necessary to fire sawmill refuse are merely the removing of the coal dump hoppers and substituting a hollow cylinder about 10 ft. high slightly tapered and made larger at the bottom and fitted with a slide gate at both top and bottom; these slides are worked with levers and the sawmill refuse is locked into the producers through these tubes.

To start firing a producer with sawmill refuse it is not necessary to have an underlying bed of cinders or ash to cover the blast pipe. The fuel can be dumped in on the water seal and fire can be started either on top or through the side poke holes. Aside from these conditions, the beds seem to be subject to all conditions prevalent in the firing of coal. A clinker is formed of a brittle nature and can be easily removed with the fine ash. The percentage of ash is so small that a producer can be operated about three weeks before removing the ash.

Cavities and chimneys will burn in the bed, and eternal vigilance and poking are necessary to produce a uniform quality of gas. In order to lessen the labor of poking it is good practice to feed occasionally, say, once a day or when the quality of the gas fluctuates, one or two charges of blocks ranging in size from stove lengths to 15 in. in diameter. These blocks will find their way into the cavities and stop the chimneys, and the producer will respond instantly. I have had cavities form low down in the beds and cause trouble, but we have always succeeded in poking down overlying fuel and closing this cavity.

We also experimented with "pine hog," and we find that it is more efficient fuel for producer gas than "cypress hog." An average of ten analyses made on gas produced from "pine hog" showed 161.4 effective B.t.u. against 130 to 135 for cypress. The reason for this is probably due to the greater heat value of pine itself as compared with cypress. The analyses of heating value of these two fuels showed that the cypress was 5 540 B.t.u., while pine was 7 605 B.t.u. These are on fuel as received, and, therefore, include moisture. The only reason that we do not use pine is that cypress is more available as far as our plant is concerned, which means that it is cheaper, comparatively speaking, although it is pound for pound a much richer fuel.

I have added below a number of analyses of gas produced from various kinds of fuel that it has been my lot to experiment with in solving our problem.