ed from slag wool, as the latter is not practicable for this purpose) is built into the form of a uniform diaphragm and is retained between two metal screens. The density of the diaphragm can be regulated by the quantity of glass used and by the degree of compression maintained between the metal screens. Ordinarily, this diaphragm is made up to a thickness of approximately one-quarter of an inch. The diameter of the diaphragm must be adjusted in accordance with the quantity of gas to be treated. Ordinarily, about 400 cu. ft. per hr. can be handled for each square inch of diaphragm area. No tar is retained in the diaphragm, both tar and gas being discharged together.

In passing the diaphragm an important change in the physical state of the tar occurs. On the entering side the tar exists in a large number of minute particles, ordinarily known as tar fog. In passing the diaphragm these particles are caused to coalesce so that on the discharge side the tar particles are of relatively large dimensions, so large in fact that they can no longer be carried forward in the gas current and immediately separate out by gravity. All that is necessary for the complete separation of the tar from the gas is to provide a sump, or drip, into which the precipitated tar can drain.

It appears to be possible to secure almost any desired degree of gas cleanness simply by regulating the pressure maintained across the diaphragm. In ordinary commercial operation, it is found that a difference in pressure of from 2½ to 4 lb. will give a degree of gas cleanness that is ample for any commercial requirement. Thirty cubic feet of gas cleaned in this way can be passed through a white filter paper without producing any discoloration.

The distinction between this process and the process of purification by filtration can be best shown by outlining the conditions essential for each process:

(1) In filtration the best separation is secured when the rate at which the materials to be separated pass the filtering medium is slow. One of the substances to be separated remains in the filter.

(2) In the process in question good results can be secured only when the velocity of the gas passing through the diaphragm is very high. Nothing whatever remains in the diaphragm.

At low velocities the gas will pass through the porous diaphragm used in this apparatus without any apparent alteration, and the degree of effectiveness of cleaning is directly related to the velocity of flow. For example, the degree of cleanness produced with the velocity of flow resulting from 1 lb. pressure, and when the velocities are as low as those produced by a pressure of a few ounces only, there is no perceptible change in the tar content of the gas after passing through the diaphragm.

No water is used in connection with this process except that required to cool the gas. As a consequence there is no production of tar emulsion and the water flows from the condenser perfectly clear. The tar separated by this process is practically water free, and can accordingly be used for any purpose to which cool tar is adaptable. One sample of tar drawn directly from the receiver showed on distillation a water content of less than 1 per cent. as compared with from 20 to 60 per cent. which is ordinarily present in gas producer tar from mechanical washers. The calorific value of producer tar from Hocking coal is approximately 15,800 B.t.u. per lb., about 140,000 B.t.u. per gal.

For the maintenance of continuous operation the tar must be sufficiently fluid to pass through the porous diaphragm without creating undue resistance, and therefore it is necessary to maintain the temperature of the gas entering the diaphragm at a point that will reduce the viscosity of the tar to as low a point as is consistent with complete condensation of the tar vapors.

It is also apparent that this apparatus would not be well suited to use on gas containing large quantities of lamp black or for purification of gas from coals yielding very heavy viscous tars. For high volatile coals, however, such as are found in Ohio, Indiana and Illinois, and for lignite, it has been found in practice to be thoroughly practical and effective. It is possible that further developments may extend the applicability of this method to conditions which are not now considered practical.

The exact method by which this tar extractor operates has not been conclusively demonstrated. Two theories have been advanced which may possibly cover the ground: The first and most obvious is that the tar particles are precipitated by being brought into direct collision with the threads or filaments of the porous diaphragm.

That this does not constitute a complete explanation of the process is indicated by the fact that the material of which the porous diaphragm is constructed has a marked bearing on the effectiveness of the process and would indicate some action other than simple mechanical collision. For example, if the porous diaphragm is made up of steel wool instead of glass wool (the physical structure of the diaphragm being as nearly as possible the same in each case) the process does not operate with anything like the effectiveness secured with glass diaphragms. It would seem that the possibility for collision would be the same in both cases.

A phenomenon, first observed by the writer in 1902 during some experimental investigations, gives further credence to the theory that there is some action other than pure mechanical collision. If the gas is caused to pass through a small tube with perfectly smooth walls, as for example a tube of glass, no particular precipitation of tar occurs as long as the velocities of travel are slow. However, as the velocities increase to a point where there is considerable friction between the gas and the surface of the containing tube a heavy precipitation of tar occurs on the surface of the glass. This fact leads to the conclusion that friction is in some way concerned in this process, since the probability of mechanical collision is rather remote. Since friction between rapidly moving gases and enclosing tubes is known to be productive of electrical phenomena, it was assumed that this might possibly have some bearing on the action of this process. In fact this interpretation was the one first placed upon the phenomenon observed in 1902 and an effort was made to work out a tar extractor along this line.

An experimental apparatus was constructed at that time in which heavily charged electrodes were employed to precipitate the tar particles and it was found that fairly effective results could be secured. Experiments along this line continued for a number of years, but the difficulties in the way of producing commercially practical apparatus caused its final abandonment. The rate at which the tar particles could be moved through the gas under the influence of moderate potential gradients was very slow. It was accordingly necessary to use exceedingly high potentials in order to secure effective results. With the spacing of electrodes of approximately 1½ in. a potential dif-