tapped at any number of points and the same potential difference will be found to obtain between them at all points, whether in close proximity to, or at the furthest distance from the source of current. Hence, there is hereby afforded a means for knowing at a supply station the actual conditions of supply at any moment in a given circuit; for, if an indicator of any suitable description is connected between the mains at the station, it will show the difference of potential obtaining, and if the circuit demands an increased current at any time, the fall of potential difference due to increased absorption of E. M. F. in the mains will be instantly shown by the indicator, which will necessarily be affected in a measure corresponding exactly to what is taking place at every point throughout the system. It will of course be readily conceived that as regards the sources of current, these may be of any form of direct current generator or may be the secondary wires of separate converters or transformers, or separate secondary wires on a single converter, the primaries or primary of which are or is in circuit with a source or generator of alternating currents; and that this method of circuit construction constitutes at once, in either of its forms, Fig. 6 or Fig. 8, a system for the distribution of current direct from a generating station, or a system for either primary or secondary circuits, or both primary and secondary circuits for alternate current distribution

A STEP FORWARD.

Now, having got to the bottom of the whole idea and acquired an exact knowledge of the results attainable by an arrangement of circuits in either of the two ways described, we can rise to a proper appreciation of its utility, and the first question to be asked will naturally be: How is it this method of circuit construction has not been heard of in practice? Well, the fact of the matter is it hasn't had a chance to put in an appearance In the shape here presented for consideration, it may not improperly be regarded as something brand new and original. It is offered in that sense. But the surprising fact obtains that one of the plans has already reached the hoary age of three years, for precisely the same arrangement of circuits as is shown in Fig. 6 is found to have been anticipated in a U. S. patent granted as far back as 1891. Unfortunately for its development, the plan as patented appears to have been arrived at along a line of reasoning different from that which has been followed in this paper, and the specification shows that the inherent virtue of the arrangement has been handicapped by a little over-dressing in the shape of a "preferred form" comprehending a cross-wire that practically relegated the improvement back to the operative conditions of the simple two-wire circuit. While this is to be regretted, it cannot be said to have done any more harm than a dam does to a river. Water eventually finds its level, even if driven to the opening up of new channels to that end, and in the same sense the attainable in our electrical field forces its way through our minds and brings whatever is of utility to the surface. That's how it comes about that inventions are re-invented and conceptions are re-conceived In the present instance, the writer was for awhile under the agreeable impression that the method we have been examining according to both plans had been devised solely by himself, until it was found some of the ground had been already covered in the way that has been mentioned. However, it is hoped a step forward may be achieved The opportunity to bring the matter to the attention of this useful and progressive association was embraced with grateful enthusiasm, and if this paper is provocative of any profitable discussion, whatever expectations are entertained of an early and widespread adoption of these plans will in all probability be realized.

Mr Campbell, in discussing the paper, said. Fig. No. 8 illustrates the same idea as No 6 as adapted to what is known as the three-wire system. Are they both of the same size?

Mr. Keeley—They are all of the same size. The three-wire system is the adoption of two dynamos. If you were using the three-wire system and you increased the voltage to 200 volts, each machine giving 200 volts—

Mr. Campbell—Do you say 200 volt lamps?

Mr. Keeley—No, 100 It does not make a particle of difference.

Mr. Campbell—Whether this figure 8 is a two-wire system or three-wire system?

Mr Keeley—It does not make any difference as far as voltage is concerned.

Mr Campbell, after some discussion on the two and three-wire systems, claimed that figure 8 was an impracticable idea altogether, as it would take four times as much copper. In theory and practice it was all wrong, and not equal to No. 7.

Mr Keeley claimed figure 8 was what he represented it to be. He had made experiments carefully, and if it was followed out carefully it could not fail to act.

Mr. Campbell—Take Fig. 6; it would take more copper, and will not give as good distribution as the ordinary parallel system.

Mr. Keeley—It would necessarily have to be a better system. The idea is this, if we were going to supply a block in our immediate vicinity I should run my leads out of this side of the house and bring them in on the other side.

Mr. Campbell—If you could instal the plant and build the town around it that would be all right, I suppose. I am in the dark to see how figure 6 is a better distribution.

Mr. Keeley—Well, for instance, you have your station, and the places you are going to supply the current to are about a quarter of a mile away. Your view seems to be that you would be running out four wires and would be using more copper than the ordinary mains. What I say is that you have exactly the same amount of copper you have with your ordinary two-wire system. The highest difference of potential you can get at any point will be that from the first end of the circuit As I have pointed out there in figure 2, you get the difference in potential, absolutely. In figure 2, you get the same potential difference between points 2 and 4 as you will get in figure 1 between the points 3 and 4. I have stated here that this difference of potential must necessarily involve that the current that is received in any one lamp is equal to that you can get at the furthest end of the circuit. Take figure 6, and supposing this is a direct current circuit we are considering. The sources of current D1 in figure 6 are direct current generators for that matter. We will take one lamp placed across between 3 and 4. It is taking one ampere. Supposing we are going away around to F at the further end of the circuit, and we put on 100 lights, we we will then have 101 amperes of current running through the circuit. It stands to reason that the electromotive force between those points is the same there with lamp F1 whether we turn on that gang of 100 or turn it off.

Mr Campbell—The current to run this 100 lamps has to run a greater distance than with a parallel system.

Mr. Keeley—No.

Mr. Campbell—100 lamps at F, and one at the other place; they are using 49 amperes at F. How does the current run from the dynamo to there and back again?

Mr. Keeley—50 amperes will run from B, and 50 from D1.

Mr. Breithaupt—I think we ought to have a blackboard at these meetings, where we could then discuss these matters thoroughly and all could see and understand.

Mr. Langton—If the lamp in figure 1 was a certain distance from the central station, say one mile, figure 5 would be the same lamp fed by two central stations two miles apart.

Mr. Keeley One mile on each side.

Mr. Langton—Figure 6 would be that system folded together so as to consolidate the central station. It shows four wires to the lamp, distant one mile from the station. If these wires are of the same size as they are in figure 1, the loss would be one half and take twice as much copper. I cannot see any difference between this and a straight two-wire system.

Mr. Keeley—If you are sending four amperes along the line with a pressure of 100 volts, you have a certain drop in the mains. Supposing you cannot connect it up in accordance with Fig. 6, you are sending two along on one side and two on the other, and you have a certain drop along the mains. In each case the drop would be one-half. In Fig. 1, instead of having 4 per cent. drop you will have an 8 per cent. drop, whereas in the other you will have only 4 per cent. and take the same amount of copper.

Mr. Langton—Fig. 5 is simply a double system of Fig. 1, and Fig. 6 is Fig. 5 folded together. They have the same lamps, you have to send out the same current, and you use twice the length of wire of the same diameter, with consequently half the loss, or you use twice the length of wire of half the diameter with the same loss.

Mr. Keeley—I claim we have a marked saving in the wire. At the same time I admit that the total amount of copper used in the four wires would be equal to the total amount of copper in the two wires. Now, the question comes in, where is the saving? It is here. The statistics of the different general central stations, as I have been given to understand, is, that out of a total number of 1,000 lamps for which wires have been put in, there is only a demand at any one time for 450. You can put it at 55 or 60 per cent. It stands to reason, at that rate, that the greatest demand at any time is only 60 per cent. on the station for the total quantity of copper that has been put out; there is 40 per cent. lying idle. If you have a system by which you can start and give an equal potential throughout the entire town instead of having to run a multitude