A STUDY OF THE ANTITRUST LAWS

HEARINGS

BEFORE THE

SUBCOMMITTEE ON ANTITRUST AND MONOPOLY

OF THE

COMMITTEE ON THE JUDICIARY

UNITED STATES SENATE

EIGHTY-FOURTH CONGRESS

FIRST SESSION

TO STUDY THE ANTITRUST LAWS OF THE UNITED STATES, AND THEIR ADMINISTRATION, INTERPRETATION, AND EFFECT

PURSUANT TO

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PART 6

GENERAL MOTORS

NOVEMBER 8, 9, 10, 15, 16, 17, 18, 21, AND 22, 1955

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A STUDY OF THE ANTITRUST LAWS

THURSDAY, NOVEMBER 10, 1955

UNITED STATES SENATE,
SUBCOMMITTEE ON ANTITRUST AND MONOPOLY
OF THE COMMITTEE ON THE JUDICIARY,
Washington, D. C.

The subcommittee met, pursuant to recess, at 10:15 a. m., in room 424, Senate Office Building, Senator Joseph C. O'Mahoney presiding.

Present: Senators O'Mahoney (presiding), and Kefauver.

Also present: Joseph W. Burns, chief counsel; Donald P. McHugh, assistant counsel; Joseph A. Seeley, assistant counsel; Gareth M. Neville, assistant counsel; and Jesse J. Friedman, economic consultant.

Senator O'MAHONEY. The committee will be in session.

Mr. Burns, are you ready to proceed with Mr. Hamilton?

Mr. BURNS. Yes. Mr. Harold M. Hamilton.

Senator O'MAHONEY. Good morning, Mr. Hamilton; good to see you.

STATEMENT OF HAROLD L. HAMILTON, RETIRED VICE PRESIDENT, GENERAL MOTORS CORP.; ACCOMPANIED BY HENRY M. HOGAN, VICE PRESIDENT AND GENERAL COUNSEL

Mr. BURNS. Mr. Hamilton, were you until recently an officer of General Motors Corp.?

Mr. HAMILTON. Yes.

Mr. BURNS. Will you tell us what office that was and what your present position is?

Mr. HAMILTON. Well, I was a vice president of General Motors; and my present position is that of a retired vice president of General Motors.

Mr. BURNS. I am going to ask you to speak just a little louder so that the people in the room who are interested may hear your testimony.

When did you first go with General Motors Corp.?

Mr. HAMILTON. In December, December 31 I think it was; that is correct, December 31, 1930.

Mr. BURNS. Will you tell us very briefly the circumstances under which you went with General Motors?

Mr. HAMILTON. Well, I was president of the Electro-Motive Co., which was a company which I had founded several years before that, and this company and General Motors worked out an arrangement whereby General Motors bought the common stock of the company, and made of it a wholly owned subsidiary.

They bought the common stock of the Electro-Motive Co., all of it, and made a wholly owned subsidiary of General Motors out of this company, and then it continued as an independent corporate structure in which I was president, and I had been president, and continued to be president.

The corporate structure was retained until about 1942, and then at that time it was made into a division of General Motors, and the corporate structure dissolved, and from that point on I was a vice president of General Motors, and retained more or less the same position so far as the direction of affairs was concerned, for some time.

Mr. BURNS. What business was the Electro-Motive Co. engaged in at the time that it was acquired by General Motors in 1930?

Mr. HAMILTON. Well, the Electro-Motive Co. was incorporated for a very specific purpose, largely by me and some associates, and the purpose was to carry out and furnish the facility for developing my ideas of the use of the internal combustion engine as motive power for railway motorcars.

Mr. BURNS. What year did you form the Electro-Motive Engineering Co.?

Mr. HAMILTON. 1922.

Senator O'MAHONEY. May I ask who were your associates?

Mr. HAMILTON. At that time?

Senator O'MAHONEY. Yes; in the original incorporation.

Mr. HAMILTON. Well, one man by the name of Paul R. Turner, who was—I will give you his temporary background. Paul Turner was a salesman in the White Motor Co., and was working under my jurisdiction at the time. He came along with me and helped me form this company.

Senator O'MAHONEY. I understand that you were with the White Motor Co.?

Mr. HAMILTON. That is true.

Senator O'MAHONEY. Your position in that company was what?

Mr. HAMILTON. At that time when I left the White Co. to form this, I was wholesale manager of the so-called western district, which included about 11 of the Western States, with headquarters in Denver.

Senator O'MAHONEY. You were a Rocky Mountain operator at that time?

Mr. HAMILTON. At that time; yes, sir.

Senator O'MAHONEY. Well, I may say that I have driven up Boulder Canyon in a White Steamer.

Mr. HAMILTON. That goes back a long way.

Senator O'MAHONEY. Perhaps I should not have spoken so frankly. [Laughter.]

Mr. HAMILTON. Well, your memory is excellent, because those Steamers did not operate after about 1910 or 1911.

Senator O'MAHONEY. I know that very well.

Who else besides Mr. Turner?

Mr. HAMILTON. The other three were—they were the people brought into the incorporation by our attorney, and they are just, they were just names; I have forgotten who they were.

Senator O'MAHONEY. They were just dummies?

Mr. HAMILTON. That is right.

Senator O'MAHONEY. Mr. Hamilton, Mr. Turner, and three dummies organized this corporation?

Mr. HAMILTON. That is right. They probably would not appreciate that appellation. [Laughter.]

Senator O'MAHONEY. I am sure that it has no application to their intellects, or to their personality qualities, but we all know that there is a great difference between natural persons and corporations.

Mr. HAMILTON. Right.

Senator O'MAHONEY. They were dummies only in the sense that they were not active in the corporation?

Mr. HAMILTON. That is true.

Senator O'MAHONEY. I do not wish to imply anything else.

Now, then, in what State was this company organized?

Mr. HAMILTON. In Ohio.

Senator O'MAHONEY. What year?

Mr. HAMILTON. 1922.

Senator O'MAHONEY. What was the name of the company, Mr. Burns, that was referred to yesterday by some of the witnesses?

Mr. BURNS. Winton.

Senator O'MAHONEY. Winton. Was this independent of Winton?

Mr. HAMILTON. Yes.

Senator O'MAHONEY. Altogether different?

Mr. HAMILTON. Altogether different, no relation whatsoever.

Senator O'MAHONEY. Were these three other gentlemen affiliated with any other corporation engaged in the automotive industry in any way?

Mr. HAMILTON. No; they were clerks.

Senator O'MAHONEY. They were clerks brought in by the incorporating lawyer?

Mr. HAMILTON. That is right; they were clerks in his law office.

Senator O'MAHONEY. And had probably one share of stock each?

Mr. HAMILTON. Yes, sir.

Senator O'MAHONEY. For the purpose of the incorporation?

Mr. HAMILTON. That is right; to comply with the statute.

Senator O'MAHONEY. Very well.

Mr. BURNS. Will you tell us what product you were interested in developing when you formed the Electro Motive Engineering Co., and the reasons which prompted you to leave the White Co. and commence this company of your own?

Mr. HAMILTON. Well, in order to provide—in order to develop a connected story, to make a little sense to people listening, probably I should go back to about 1905.

Mr. BURNS. Will you do it briefly, just to give us the main points which caused you in 1922 to form this company?

Mr. HAMILTON. That is right. But to do that I have to supply a reasonable background and establish how my thinking developed and took form which resulted in a decision to make this move and form this company.

Mr. BURNS. Will you do that, please?

Mr. HAMILTON. About 1905, I am not being specific as to specific dates, but it is the period, the Union Pacific Railroad, largely under the instigation of Mr. Harriman, who was at that time important on that railroad, launched an enterprise, with the assistance of the mechanical department of the Union Pacific, and a man by the name of McKeen, to develop some form of a small rail motorcar—the name

was not given that way—but a small vehicle that could be used on the railroads to take care of light passenger train requirements in place of the steam locomotive and 2 or 3 cars, which was the conventional practice at that time.

This company evolved a very well-defined car that had a capacity of about 50 or 60 passengers, with a gasoline engine, and the necessary mechanical means of transmitting that power to a driver on the rail.

The railroad, through its subsidiary arrangement, which was known as the McKeen Motor Car Co., between that period of about 1905 and the beginning of World War I, built and put on their own railroad, as well as the other so-called Harriman lines, and some other railroads, 7 other railroads, quite a number of those cars—probably, I do not know offhand—but I think in order of 150, 200 of them.

Now, then, another development got in motion about that time of this same character, and that was by the General Electric Co. They evolved a car of similar character, similar size in horsepower and in characteristics, but they used an electric transmission to transmit the power from the engine to the drivers instead of the mechanical transmission. They built some 80 or 90 of those cars during the period preceding World War I.

When the war came on all that activity ceased on the part of both companies.

Then during the war itself and following, shortly following the war, with many of the railroads in what they thought were in need of that sort of equipment, particularly the short line, the so-called short-line railroads of America, which means all of the railroads with less than a hundred miles of track in those days, got to different motor-vehicle builders, like the bus companies and the truck companies, got them interested so that there were quite a number of vehicles out on the railroads put together by the different truck companies that consisted of buses, converted to operation on rails by simply putting flange tires on the vehicle in place of rubber tires and making some other modification, not very extensive; so that at the end of the war there were quite a number of vehicles of that character operating on particular lines, particularly short lines, and so forth, over the country.

Now, my interest in this picture developed something like this: At the end of the war when I went—after my tour of duty that arose out of the war—I went back to the White Co.: I had been with them before the war—and I was assigned the district manager's job in Des Moines, Iowa, and I soon found about a half dozen or, in fact, about a dozen of these buses running on rails that had been sold by the White Co. in my territory.

I also discovered that they were giving us more trouble than any of the rest of the vehicles we had delivered, and our service people were spending most of the time trying to keep them running, so I got a quick introduction to that one.

As time went on, in order to make up my mind what was wrong and what we were going to do about it, I took a good look at the vehicle, spent a little time watching them operate, discussed the matter with our service people, and came to a firm conclusion that the vehicle was fundamentally wrong for operation on the rails, and there was nothing we could do to correct it except to rebuild them when they broke up, which occurred regularly.

I not only insisted that we would not sell any more, but that no more would be sold in my territory. I did not want our service people to have the responsibility of trying to keep them running.

At that moment I made up my mind as to what was wrong with any form of a mechanical hookup between an internal combustion engine and a steel wheel running on a rail. So much for that. That was 1919 that I talking about.

In 1920—I was then in the meantime made wholesale manager of the western district, which put me in Denver, Colo., and gave me all the Western States except the three coast States, put them all under my jurisdiction, and I found a lot of these vehicles running then.

So my headache increased rather than decreased.

But in the meantime, the White Co., in its search for business, decided to expand their motorcar program, and I did my best to discourage it, to the extent that I had an agreement with the president of the company that we would not deliver any more of that type of vehicle in my territory.

Now, during this time—and this may sound irrelevant, but it is not, you asked how I happened to get started—during this period, the territory that I had responsibility for included nearly all of the national parks, Glacier, Yellowstone, Rocky Mountain National, Mesa Verde, and a group of the Rocky Mountain parks. All of the motor-vehicle transportation in those parks at that time were fleets of White buses that we had sold, so we were in constant contact with these transportation companies; and in addition to that they had worked out coupon tickets so that all the railroads of the area sold tickets for passengers to circulate by the railroads through the park on another railroad through the next park, and so on.

So I was also in constant contact with the railroad people, particularly the passenger and traffic people, lived with them, traveled with them, and we worked out our problems jointly.

They were constantly saying to me, "Why don't you people build a vehicle like these buses that we ride in through Yellowstone or through Glacier, wherever we may have been; why don't you build us something like that that will operate on the rails so we can cut down our costs of operation on these small lightly loaded branches?", and so forth.

I told them it could not be done. It was not in the cards. We could not build a vehicle that could live, and I told them why. But the conversation on that one kept on until I realized, being primarily sales minded in the matter, realized that there was a tremendous opportunity for somebody to develop a vehicle of the right character, if they could develop the type, the correct vehicle, the market was ready and waiting.

The question was how do you do that. So my mind started exploring around on it.

Now, previous to my experience with the White Co., I had started as a youngster in railroading. I learned the operating side, at least the mechanical side, of railroading the hard way, and I had gone out of there with the White Co., so I understood railroads fundamentally, their operation and their problems, particularly from the rolling-stock angle.

So I felt I could evolve a design that would meet railroad requirements at that time.

I knew the story of the failure of the other efforts that had been undertaken, to some extent. I was not particularly familiar with General Electric at that time, but they had built a gas electric car; I knew about the McKeen car; I knew about all the modified motorcars, the rail buses, and so forth, which were really highway buses.

Well, it was my concept that what was needed was a transmission that could only be done electrically, and by a complete conversion of energy, for the benefit of the record, the introduction of a generator or dynamo and an electric motor in combination between the engine and the driver. That was a necessary element to accomplish the objective for two reasons: Not only to take the shock, the mechanical shock, that normally arises from the contact of the rails, the driver on the rails, but also to convert the horsepower and torque characteristics of an internal-combustion engine so that it is suitable for traction purposes on a railroad; a very difficult thing to do mechanically, and that is one of the reasons why the failures had occurred previously.

So I evolved what, in my opinion, was a vehicle that would function properly. Then I asked the White Co. for a leave of absence to make a survey to find out why somebody had not done that, and why, what seemed simple to me was not being done at the time.

I soon discovered on my survey trip that the General Electric had made such a vehicle and then discovered what I have told you earlier here.

Well then, the next step was to find out why they did not continue to make it, and why they were not acceptable, why the railroads were not buying them and using them.

I knew their interest in that sort of vehicle. So I made up my mind after a check with the railroads that had some of these General Electric cars, what was wrong with their particular approach to the problem.

Well, I, at least, decided this: That my solution was all right, and that what I proposed to do would improve on the General Electric's effort, and eliminate the weaknesses that had prevailed at that time, and that I could produce a motorcar that would be satisfactory and would meet the commercial requirements that these railroad men were talking about.

Senator O'MAHONEY. Were there any patents involved in the General Electric engine?

Mr. HAMILTON. No; nothing of any consequence at all because it was a very simple setup. It involved—I say patents, now I might be technically wrong. There were none on the engine, none on the generator, none on the motor, but they used what was known as a Ward-Leonard control, and there may have been patents on that device, but that was in common use in those days in lots of practices, particularly in ships.

Senator O'MAHONEY. Did your modification involve any patent?

Mr. HAMILTON. No. There may have been a minor 1 or 2, but not from our standpoint. If I am supposed to go that far into it, I can answer your question more specifically, Senator.

Senator O'MAHONEY. I think it is very interesting and very important.

Mr. HAMILTON. Because at a later date we get into that, and if you want more detail on that point, I would be delighted to supply all you want.

However, as I say, the starting at scratch to build a motorcar with me—I had no resources, except my own personal resources—was a difficult undertaking. But I decided the opportunity was so great that I could not ignore it. So I left the White Co. and decided to incorporate a company of my own. That was in the summer of 1922. The company was incorporated in August of that year, as we have indicated.

Well, I ran up against a lot of problems, which I will not attempt to cover, only in some detail here. I first went to one major electrical company, and their engineers said the idea that I had for electric transmission probably could be done with considerable development, and very likely be inefficient, so much so, that they would not go along with it unless I was ready to finance the research that was involved. I was not ready to do that.

So then I went to the General Electric Co., and I met a quick brushoff there at the outset because I met the higher officials, and their reaction was this: that they had made an effort of that kind, and that the total loss that the company wrote off was about $1,500,000 in their effort, and they did not feel like they wanted to make another try in that direction.

However, there were people in General Electric, engineers primarily, that were left over and had been involved in the original development of the General Electric product that they had made, who still had faith in the whole program, and agreed with me as to why the General Electric car was not a commercial success, and was not accepted wholeheartedly by the railroads in view of the fact that they did want such an animal, or such a vehicle.

So by working backwards through this group of individuals, and all of them important engineers in General Electric's setup, we revived the general interest in the program, and eventually got the approval of the officers of General Electric to develop a generator with a control characteristic which I had outlined as required, but not enough of an electrical knowledge of my own to know how to do it.

That electrical knowledge, how to do it, was supplied by General Electric engineers. They thought they knew, and as time went on, it proved they did know how to do it, and we did it.

That is the point right at that part there, Mr. Senator. There may have been some General Electric minor patents involved in the technique of the control, and if so, they were General Electric patents and not ours. We had nothing to do with that angle. That was a highly scientific development.

In the meantime, I had taken a good look, and much to my surprise, discovered that there were no engines built in America at that time that were suitable for the job that we had laid out or for the requirements that we had set forth, as being necessary for this vehicle.

So, in order to carry out, however, the test of the first generator that General Electric was building, we needed an engine of certain characteristics.

I found such an engine, and bought one, and it was delivered to General Electric, and we put together the original test mockup, which was a small locomotive, electric locomotive, that was there, a switching engine that they worked over, and we put the engine and generator into it, and we ran a series of tests for a long time at the Erie Works of General Electric, and in that process, we developed definitely that

the transmission, which was what we were really serious about or were concerned with, would do what we wanted to do. It met all of the specifications that we had laid down, and the characteristic requirements at the outset.

However, the engine that we had hooked to this generator, and which we thought was the best engine available in America, had gone to pieces in about 90 days of just ordinary yard operations there in switching cars at the Erie Works of General Electric, so that left us flat.

Now, you understand, at that time we were not even thinking in terms of diesel. We were only thinking in terms of the gasoline engine, because the diesel was so far away from our picture at that time, so far as it state of development, as not even to be entertained. We were only thinking in terms of a gasoline engine.

Well, eventually, without going into all of the horrible details that went along with this, I made the acquaintance of what was then the general manager of the Winton Engine Co. in Cleveland, and I would like to digress here for just a moment.

There were inferences made here yesterday in the testimony that this little company, known as the Winton Engine Co., was of minor importance in the industry.

Now, the facts are that the Winton Engine Co., at that time, was one of the major diesel-engine producers in America, and was the company which made the relatively lightweight and fast-running type of diesel used in tugs, fishing boats, yachts, and so forth, at that period.

Senator O'MAHONEY. What year was that?

Mr. HAMILTON. The period I am talking about was 1922, 1923.

Senator O'MAHONEY. The Winton Co. also made automobiles, did it not, about that time?

Mr. HAMILTON. Not this company. That was a separate enterprise entirely. It is true that the Winton Automobile Co. was naturally, as most everybody knows, the company started by Alexander Winton, one of the pioneers in the automobile business, and he had two associates, Mr. Henderson and Mr. Brown. They had been together for years, and they built up the Winton Automobile Co.

Then along about 1916, Alexander Winton became very interested in the idea of building a diesel engine, and decided he wanted some diesel engines for his own yacht, so he built a pair of diesel engines in the automobile plant for his own yacht, and that intrigued him, and he thought he ought to have an engine plant or an engine company to build diesel engines for boats, and he organized this company of his own. It was a wholly owned affair, and it was completely separate and independent of the automobile company, not in anyway related, except, of course, he staffed it with people that he had taken out of the automobile company, but it had no relation to the automobile, other than that.

Senator O'MAHONEY. He was the head of each company?

Mr. HAMILTON. I beg pardon?

Senator O'MAHONEY. He was the head of both companies?

Mr. HAMILTON. That is right. But it was an important thing from the technological standpoint and from the development standpoint. In the historical development of the diesel engine in America, Winton made a major contribution at that time.

Senator O'MAHONEY. Would it be proper to say that he might have been the pioneer of diesel development in this country?

Mr. HAMILTON. No, you cannot say that; you cannot say that.

There were a lot of firms pioneering, but most of them were all going in slightly separate directions.

Now, the first diesel engine, according to my reading of the history, the first pure diesel, and there is a lot of confusion as to what a diesel is in the mind of the public and the scientific world for that matter—but anyway, the first pure diesel manufactured in this country that I am aware of was built by Mr. Busch of Anheuser-Busch, in St. Louis.

He acquired, as I understand it, and I got this from the historical record, and if the record is correct and I am correct, from Selzer Bros. in Switzerland, a license to build an engine under Rudolph Diesel's patents, and he built himself a machine shop or a plant, if you like, eventually, in St. Louis, and thus the building of diesel engines in this country; and for a long time they were somewhat dominant, and were the only ones building a pure diesel.

There was very little, if any, if I am correct, any pure diesels built in this country until after Rudolph Diesel's patents expired, which began to be at 1911, and then we began to get into pure diesel.

There were a lot of modifications that took place in there, but they were not diesel engines; they were just half diesel engines.

Now, getting around to our program again, I went to the Winton Engine Co., which was there in Cleveland, got acquainted with their president, and told him what my problem was.

After looking over what they had to offer in the form of gasoline engines, they did build moderate-sized gasoline engines for boats and so-called marine engines at that time, but nothing they had to offer was suitable for our purposes.

The chief engineer, a man by the name of Salisbury, and Mr. Codrington, who was general manager at that time, and who agreed with me what we wanted to build was perfectly practical as an engine, and would be a good engine, and as long as we said it was suitable for our purpose, why, that was all right with them.

But at that time—I do not know whether this detail means anything or not, but it helps to show what some of the problems were at that time, and I think I would like to get that in the record in view, particularly, of the testimony that I heard here yesterday—the engine requirements at the moment, according to our concept, at least, involved an engine that had to be built brandnew or designed brandnew from the bottom up, and the Winton Engine Co. at that time, owing to the receivership of the automobile company, and Mr. Winton's assets and all the rest of them having been involved in that matter, the Winton Engine Co. was in the hands of the bank, and they were in no position to introduce or to spend any money for a new experiment of any kind of the character that we were talking about, particularly when so far as we, so far as I was concerned, and the Electro-Motive Engineering Co., which was the name of the company then, the automobile company—that is, the engine company, the management of it and the bank did not feel that this proposition offered enough future and was secure enough, was a secure enough future for them to venture the capital involved to develop a new engine.

So Mr. Codrington suggested we go talk to Mr. Winton personally, which we did. He came to the office; he was getting to be an old man. He came to the office occasionally but we went out to his residence, sat down and had a long talk and, of course, even in his last years, he had the spirit of the pioneer; his eyes would light up when we were talking about what we were going to do, which was something new and novel and off into the future. It was a forward development.

So, after Mr. Codrington told him what we wanted, and after I described what we hoped to do and the potential possibilities that I thought existed, without any other word he simply got up, put his hand on Mr. Codrington's shoulder, and said, "Go ahead and build it, George, and send me the bill."

Well that, of course, gave us a green light to move ahead, which we did.

Mr. BURNS. Would you spell Mr. Codrington's name for the record?

Mr. HAMILTON. C-o-d-r-i-n-g-t-o-n.

Well, after Winton completed the engine, which they did, in the meantime General Electric had built us our electric equipment, and we put the two together, and they functioned.

In the meantime we had established some relationship with car builders to build the structure we wanted, more or less to our designs; so we introduced and put into service in 1924 two cars, both alike. They went into service in 1924, gas electric, as they were called at that time.

They had 175-horsepower engines. One went into service on the Chicago & Great Western; the other one on the Northern Pacific.

They were sold—the order was taken, if we want to call it an order, by me on this basis—I am introducing this into the record to show a state of mind that existed at that time.

I will digress for a moment to get back to this state of mind, as I call it.

The McKeen effort, the General Electric effort, the efforts of the large motor-vehicle manufacturers during this period, which included nearly all of the big names in the industry at that time, had offered and had sold and delivered to the railroads their version of some form of a rail car, and in 1 or 2 cases there had been separate companies formed to take this same philosophy of design and expand it into bigger vehicles.

Yet, following automotive practice, all of them—apparently, at least, and to the mind of the railroad people—had been more or less failures.

So, by the time we introduced the gas electric car of our design in 1924, there was a sour state of mind in the mind of the railroad people.

Senator O'MAHONEY. These were all gas electrics?

Mr. HAMILTON. Which is that, sir?

Senator O'MAHONEY. The three that you have indicated, the McKeen engine, the General Electric——

Mr. HAMILTON. No. McKeen was mechanical; General Electric was electric only.

Senator O'MAHONEY. Electric only?

Mr. HAMILTON. Yes, sir.

Senator O'MAHONEY. And then the others?

Mr. HAMILTON. Were all mechanical.

Senator O'MAHONEY. All mechanical?

Mr. HAMILTON. Yes, sir.

Senator O'MAHONEY. So now we come to the first gas——

Mr. HAMILTON. Gas electric.

We come to our gas electric, which was really a modern version of what General Electric had done before, several years ago.

You see, we have got to keep in mind now that the design of the General Electric car and the engine and all the components represented engineering and technical knowledge of the art in 1908.

Senator O'MAHONEY. What I wanted to be clear about was whether the engine which Mr. Winton agreed to finance, the construction or experimentation of which he agreed to finance, was a gas electric or a diesel?

Mr. HAMILTON. No, a gas electric.

Senator O'MAHONEY. That was a gas electric?

Mr. HAMILTON. Yes, sir.

The first car—and I am still talking about those now—met this state of mind or atmosphere that existed in the country, and it was quite hostile.

So before we had completed these cars, when I went out to see if we could sell them, I had to make this sort of guaranty to get the first order, and the guaranty was this: First, we gave them charts showing how fast the car would run under all operating conditions on different grades; how fast it would accelerate from zero miles per hour up to its maximum speed; how fast it accelerated hauling a 35-ton standard railroad coach behind it under all of these conditions; and these curves were to be guaranteed. That was part of the condition of the deal.

In other words, we would set up a test piece of track, stake it out, run it, a typical engineering test, to prove all of this performance, as we called it, that we had guaranteed.

Senator O'MAHONEY. You were to make the test before the sale?

Mr. HAMILTON. No. It was this way, Senator: They had given me an order that if the motorcar would meet all the conditions they would pay for it, but if it did not, it belonged to me.

Senator O'MAHONEY. So you undertook to build a motor that did meet these conditions?

Mr. HAMILTON. I beg your pardon?

Senator O'MAHONEY. Then you undertook to build a motor that would meet those conditions?

Mr. HAMILTON. Yes, sir.

Senator O'MAHONEY. Confident that you could do it, and confident, therefore, that you would get your money?

Mr. HAMILTON. That is right.

There was one other requirement in this contract that was more difficult by far than the performance requirements, because those were all subject to engineering calculations, and we could do it if we were as good designers as we thought we were; then the motorcar was bound to meet those conditions.

But there was another factor over which we had no control. It was in the laps of the gods, and that was this: That the motorcar was to operate on a schedule run for 30 days, and not to be late at the final terminal over 15 minutes, two times. If it did, the guaranty was—the motorcar belonged to me, and the railroad's obligation had been met, so to speak, or they had no obligation.

That meant, in order to establish these two motorcars, and the reason that was so tough was because everything that had been done in that field up to that time had left such an odor behind that no railroad was going to take an obligation to buy anything in the form of one of these gadgets or whatever you wanted to call it—they had all kinds of names for them, incidentally—unless they were sure that it was going to function, and it did not have the weaknesses that had prevailed before that.

That is why they made these guaranties so tough.

So here we were. We were a small company with limited funds, and we had these 2 cars built, and our success hinged on whether or not they met the guaranties, whether they would run for 30 days.

Now, you keep in mind that a broken spark plug, a little dirt in the fuel line or a drop in brake hanger or an airbrake failure or a million things could happen to that mechanism of that kind that would cause a delay on line, so that you would be 15 minutes late at the final terminal.

We had some fast experiences, I assure you, during that period of time. I will not go into detail on that.

Senator O'MAHONEY. What did it cost to build these engines?

Mr. HAMILTON. The engine itself?

Senator KEFAUVER. The whole thing.

Mr. HAMILTON. Or the entire motorcar, Senator? The whole car?

Senator O'MAHONEY. I meant the whole car that you were selling.

Mr. HAMILTON. The car we were selling at that time, I think as I recall it now, sold for about $48,000, the entire vehicle; that was the selling price of the vehicle.

I am going on memory, because we eventually made them a little larger, and we got up to $55,000. I think that was $48,000, to begin with.

Well, we put these two motorcars on their runs, and with some very fast plays that we had to employ during the period because of failures that did occur, things that did happen, but nevertheless they completed their 30-day test to the satisfaction of the railroad.

First we ran the tests against the curves or the performance data that we had guaranteed, and they met those. Then we put them in service, and at the end of the 30 days we had met the requirements there. So, of course, we got our money and, likewise, an order for more motorcars.

The reason I am going into some detail on that one was this, that at that time the railroads were still buying a few of the so-called mechanical drive vehicles built by the different bus companies and others that were specializing in this business at that time.

Almost immediately that buying ceased, and the entire interest in that type of vehicle was switched over to the gas electric, and our business expanded just like an inverted pyramid from that point on, that is, during the balance of the twenties.

Eventually, we had competition. Other people came into the field to build a similar car, so we were not alone.

By the end of the thirties, why, I think there had been three people in the business.

Mr. BURNS. Mr. Hamilton, at the time that you satisfied the requirements of these railroads in 1924, was your car the only gas-electric

type vehicle operating on the railroads, as far as you know, in the United States?

Mr. HAMILTON. Yes, sir; except the remnants of the old General Electric cars. There were still a few of those operating, but that was the only car that was being offered for sale at that time, being manufactured in this country.

Mr. BURNS. All the others that were being offered for sale were with mechanical transmissions?

Mr. HAMILTON. That is right.

Mr. BURNS. Were you the person who was chiefly responsible at that time for the conversion of the thinking of the railroad people to accepting this gas-electric type of vehicle?

Mr. HAMILTON. Well, this vehicle that I have just described, and those that followed immediately, established their own reputation. They hewed their own way, because they were reliable. They did what the railroads wanted done, and always said they wanted in a vehicle of this kind.

They were economical; they would cover their run successfully, and they operated for around 30 or 40 cents a mile as against a dollar or a dollar and a quarter for the steam train they replaced, and they could run them two or three, four hundred miles a day if the run was available, so that the economy was tremendous, and their interest developed fast, and the motorcar established its own reputation, and that is what carried the thing along.

Mr. BURNS. And that was based on the successful transmission into a practical rail car of the ideas which you had developed in forming this company?

Mr. HAMILTON. Yes, sir; except I would like to add this point right there: There is a whole lot more to a motorcar and a whole lot more to a diesel locomotive than simply the transmission.

The entire motive-power mechanism that goes into these vehicles must be a coordinated whole. They must be designed so that they function together as a compatible mechanism, and that involves a lot of apparatus in addition to simply the electric transmission.

Now, to be more specific, I am convinced and others are, too, now that the internal-combustion engine—should I explain what I mean by an internal-combustion engine, Senator?

Senator O'MAHONEY. We hope a lot of people will read these hearings, so I think you might do that.

Mr. HAMILTON. We use the term in the engineering world to differentiate between a steam engine and what we commonly know as a gasoline engine or a diesel engine. So we call it an internal-combustion engine, and the general characteristics there are no different between a gasoline engine, a gas engine, and a diesel engine in that respect, because the combustion is all internal, it is all inside the cylinder, and that is how the name was generated.

So the characteristics, the horsepower output, and the ability to do work of an internal-combustion engine are such that it is completely backward for the application into a mobile power, without the introduction of a very flexible scheme of transmission.

You can do it well in an automobile, because you have got a light vehicle, and you can maintain, get some momentum, and then you can shift gears, and the car keeps rolling while you are shifting gears, and

you are in the next one, and you drop your clutch in, and so on and so on and so on.

But if that automobile weighed on the order of 20 tons instead of 4,000 pounds, and you tried to shift gears and make it go someplace with this little engine, then you would discover what the problems are in converting the power of an internal-combustion engine down to the drivers.

So it was our contention then, and it was our subsequent experience, which has proven that, without an electric transmission introduced between the engine or the prime mover, in this case the internal-combustion engine, either gasoline or diesel, the final result is unsatisfactory, and so, answering your question, I would say yes, the electric transmission is definitely necessary, but I want to establish the fact that that was not the whole story.

If the rest of the mechanism in that motorcar had not also been correctly designed and compatible so that they worked and lived together, a balanced design, then the motorcar would not have been a success, regardless of the transmission. It required a whole piece, everything to be the same.

Mr. BURNS. Can you describe briefly the developments from that time until 1930, so that we can see what the situation was at the time that General Motors acquired your company and the Winton Co.?

Senator KEFAUVER. Mr. Chairman, may I ask a question for my own interest?

Is much energy lost in the transmission of power from an internal combustion engine through an electric generator and then through the drive shaft, or is there much loss of energy in that process?

Mr. HAMILTON. That is right. There is a loss of energy. The loss of energy on the generator, depending on who builds the generator—of course, there is a slight variation—but the generator efficiency, as a whole, runs in the order of 93 to 95 percent.

Senator KEFAUVER. So there is a 7 or 5 percent loss of energy?

Mr. HAMILTON. At that point.

Then you have the traction motor, and the efficiency of the traction motor varies in proportion to the output but, normally speaking, they are on the order of 85, 86 percent efficiency, so you add that differential in there.

So when we talk about transmission efficiency and transmission as used in these diesel electric locomotives which we are to get, I have to make one more qualification there, but what we are dealing with is a complete conversion of energy. You start out with mechanical power in the engine, which is converted into electricity in the generator, the dynamo, as the public knows it, and then we reconvert that electrical energy back into mechanical power by the traction motor in order to rotate the drivers, so technically we call that complete conversion of energy.

The reason I make that differentiation is that there have been transmissions built in which there is no conversion; there is simply the armature and the field coils so controlled as to make a slipping clutch sort of arrangement that has always been called an electric transmission, but it is really a magnetic clutch, but there is a difference.

When we get to the type we are talking about here, the efficiency values that we deal with are in the order of overall 85 to 86 percent.

Senator KEFAUVER. Thank you. Excuse me.

Mr. BURNS. Now, will you tell us about the development from 1924 to 1930.

Mr. HAMILTON. Well, the development during that period of time, so far as we were concerned, we were dealing all the time with refinements, improvements, and taking care of weaknesses that we discovered as we went along and had experience.

But the interesting phase of it that you have in mind or the important phase of it, is what happened in that period of time from the historical side. Well, it was this:

The railroads, as soon as they got a few of these motor cars, did the typical thing. They started hauling behind them first a little lightweight coach, 35-ton coach, and we had only guaranteed to haul a 35-ton coach, and pretty quickly they found that the 35-ton coach was old, and people did not like it, so they had to put on a better coach to satisfy the community, and that better coach was a modern steel car that weighed about 60 tons. So that interfered with the performance. So the demand immediately arose for more power. We provided the horsepower. We stepped up the horsepower.

The next thing the railroad sees is that they have only 2 motorcars, and they want to reach into the next bracket to get where they can handle 3 cars, so that means still more horsepower, and we have got to step it up, so we went through that process to step up the horsepower to handle bigger trains, if you will, more cars, until about 1930 when we had reached 800 horsepower, after starting with 175, we were up to 800 horsepower. We got the 800 horsepower by multiplication.

The largest engine we had built and put into service at that time was 400 horsepower for engines, so we multiplied that, we put two of them in the cab, and we came up with 800 horsepower, and that was about the ceiling, and that is where we were in 1930.

Mr. BURNS. Were there any other companies in 1930 manufacturing the same size and type of gas-electric car that you were making?

Mr. HAMILTON. Yes. There were people manufacturing the same type. Their sizes of horsepower, and so forth, did not necessarily parallel ours, but in a smaller size, yes, there was one that was made with 300 horsepower, and there was another one of 500 horsepower.

Mr. BURNS. Can you give us the names of those companies?

Mr. HAMILTON. Well, the 300 horsepower was the Brill Co.

Mr. BURNS. ACF Brill?

Mr. HAMILTON. ACF took over the Brill Co. later, but at that time was an independent company, as I remember it, or the consolidation occurred in that period.

The other one was the Westinghouse Electric Co. which was a diesel engine, incidentally, not a gasoline; those two.

There was one other, I think the Mack Truck Co. went in and made a little start in that direction, but they never introduced, built enough, to have any importance.

The two competitors of consequence were the Brill Co. and the Westinghouse Electric.

Mr. BURNS. What did your company actually make in the cars that were sold? That is, we would like to have an explanation of just what part your company played in the actual manufacture, and also was it your company that sold the complete vehicle to the railroads?

Mr. HAMILTON. Yes.

The arrangement was this: We did not ourselves, Electro-Motive Co. which, incidentally, the name had been changed in that interval—when we started out—I might digress for a moment so as to clear the record—the company initially was the Electro-Motive Engineering Co., and after a couple of years we found ourselves getting so many inquiries in the mail involving all sorts of engineering problems and inquiring would we undertake this and would we take some other engineering, inasmuch as we were specializing only in this one thing, we decided we might just as well get rid of that name "Engineering," because we were doing business only with the railroads; they know what we were and who we were, and we did not need the name, so we became the Electro-Motive Co. along about 1925, in that neighborhood.

Now, getting on up to the point as to our—I kind of lost my point there now.

Mr. BURNS. What parts you were selling.

Mr. HAMILTON. What our parts were?

Mr. BURNS. What parts did you manufacture?

Mr. HAMILTON. The Electro-Motive Co. did not manufacture anything. We had no manufacturing facilities. We had a very close working arrangement with the Winton Engine Co., and we initially had established a very close working arrangement with one of the car builders of St. Louis, later on—and the electrical equipment was supplied by General Electric or Westinghouse as time went on; they came into the picture and supplied some for us, too; and then the other components of varying pieces of apparatus that are necessary, we procured from the original manufacturers.

Then the cars were all built to our specifications at these different car plants. We collected all of the equipment at those plants, and with a crew of supervisors, not hourly people, but supervisors on our payroll, the equipment was all installed in these cars, whether it was at the Pullman plant, St. Louis plant, Standard Steel, broadly all over the eastern part of the country, wherever these plants were, the cars were built.

Now then, we took full responsibility. We sold the motorcar. worked out general and operating studies, and economic studies of where the motorcar would be applicable from an economic standpoint. We sold the motorcar.

We took full and absolute responsibility for its performance and all of the after-sale guaranty for the railroad, the car builder, the engine builder, the electric people; nobody was involved but us. We handled all of that.

We also set up, to support the motorcars in service, parts depots, as we called them, all over the United States. I say all over. They were strategically located so that at no time was one of these cars over 24 hours away from a spare part. If any one of them failed, we could get a new piece to it in 24 hours any place, whether it was in Spokane, Wash., Portland, Maine, or Miami, Fla. In other words, we had them so located we could do that.

Mr. BURNS. Those depots were owned by your company?

Mr. HAMILTON. They were owned by us.

Mr. BURNS. And you serviced from them?

Mr. HAMILTON. That's right, but other than that as a sales service and guaranty engineering development company, that was the nature of the Electro-Motive Co. in those days.

Mr. BURNS. The other companies that sold vehicles that were supposed to serve the same purpose, did they try to, or did they make the identical type of car that you were making by 1930?

Mr. HAMILTON. Very close to it; very close to it.

Mr. BURNS. There was nothing to stop them from doing it?

Mr. HAMILTON. No. On the other hand they had a lot of help because the electric transmission, which by that time had been developed by a lot of blood and tears and perspiration on the part of General Electric and ourselves, working out the bugs and taking the losses that it involved, was available to them right on the shelf. All they had to do was call up General Electric and have it shipped to them.

General Electric was selling it to anybody that would come and pay for it. They were in no position to make an exclusive arrangement with us, in spite of the fact we had, more or less in conjunction with their people and engineers, evolved this.

Mr. BURNS. Now what was the nature of this diesel electric which Westinghouse was making at that time?

Mr. HAMILTON. That is a quite a tale. I am afraid you would be bored to tears before I got through with that. I don't know how I can shorten that one up either.

Senator O'MAHONEY. I can assure you that to date you have been boring the chairman not at all. It has been very interesting, sir.

Mr. HAMILTON. Thank you, Senator. Well, maybe if I can tell that story so as not to confuse everybody and boil it down to where it makes some sense, I will attempt to do it. I will try to make it as short as I can.

Mr. BURNS. Will that help to explain the differences between what your future developments in diesel were?

Mr. HAMILTON. Yes, it will have a place in what is going to be said later on as to what the problem was.

Mr. BURNS. Would you rather refer to that when you are discussing your own development of diesels?

Mr. HAMILTON. I think so. We will just leave that one on the shelf and come back to it, if it suits the Senator.

Mr. BURNS. All right, tell us the situation in 1930 at the time that your company was taken over by General Motors. At that time were you getting your engines entirely from Winton?

Mr. HAMILTON. Yes.

Mr. BURNS. And you were getting the electrical equipment from General Electric?

Mr. HAMILTON. And Westinghouse too, by that time.

Mr. BURNS. All right, now, what was the business situation and the technological situation at the end of 1930?

Mr. HAMILTON. Well, the problem was primarily one of economics at that stage. The railroads, as I said to you and as I indicated a while ago, had stepped up their horsepower requirements to where we were thinking—everything we were building at the later period was 800 horsepower.

Now, in the meantime, when we launched this program back in the middle twenties, the price of gasoline in bulk bought in tank cars, which is the way a railroad buys it, was in the order of 4 cents a gallon.

That varied some places, it was 5 some places, and 3½; in Texas you could get it for 3½ cents a gallon.

By 1930, however, it was in the order of 14 cents a gallon, 12 to 14 across the board, so that our economic advantage from the cost of fuel standpoint was running backward on us, so to speak.

Now, then, by increasing the horsepower requirements up to 800 as against the smaller horsepower, then our fuel cost, because of the size of the engine on the one side and the price of the fuel on the other, brought the operating cost of that sort of a vehicle, 800 horsepower as against steam, steam engine, it narrowed the gap down to a point where the economic advantage of buying these motorcars commenced to disappear.

Then there was another factor that was involved, and that was that, during the twenties, we had the greatest hard surfacing campaign for rebuilding highways in America that took place, as we all know. By that time buses and highway motor vehicle traffic had further cut into the passenger travel on these branch lines that the railroads had to operate, secondary main lines and so forth, so that before they would buy a vehicle to supplant the steam engine on some of these runs, in many cases the run had an income or the train had a revenue of maybe 30 cents a mile and it costs them $1.50 a mile to run it. So they would go to the State commissions and ask for relief, try and get many of those trains removed, the privilege of taking them off. That was a step that had to be done under the law, and that is what they did.

So they had all of these, or many of these, requests before the commissions in all the States all the time. And as they finally got approval, they would fluff off certain runs, and those that they could not get approval on, then they would buy motorcars to try and reduce their losses.

Now then, those two factors operating together had resulted in a ceiling on our business. We had come to the end of the road because the amount of buying of motorcars under that combination of circumstances had shrunk down to where we had really saturated the market.

That combination of circumstances had saturated our market. How much further do you want me to go on that, Mr. Burns?

Mr. BURNS. In 1930, the end of 1930, the stock of your company was sold to General Motors. What were the events leading up to that transaction?

Mr. HAMILTON. Well, the steps are a little involved there because, to some extent, they include the Winton Engine Co.

Mr. BURNS. Will you go back and tell the steps leading up to it?

Mr. HAMILTON. Chronologically it might be better for me to cover this phase of it a little more and then bring that other into the story so that it doesn't get too confusing.

Mr. BURNS. All right, proceed.

Mr. HAMILTON. This problem that I have just indicated that faced Electro-Motive at that time was not taken easily nor lying down so far as the Winton Engine Co. or ourselves were concerned.

One of the efforts that we made was to try and learn or use as a fuel in these engines so-called engine distillate, which was a by-

product, or was at that time a by-product of the Burton cracking process, and it has characteristics that are so different from gasoline that the trick of burning it in an engine of this kind, gasoline type of engine with carburetors and spark plugs, and was very difficult.

But we made an effort in that direction, spent a lot of time and the fuel at that time was available on the order of 3 cents a gallon. In fact, down in Texas you could get it for hauling it away from the refinery because it was a byproduct of no value.

So we attempted to devolve carburetors and other devices and gadgets to see if we could burn this low-grade fuel.

We could, on certain operations where a motorcar was in a relatively constant load where they started up a grade and stayed with full horsepower and didn't shut off at the top and start and stop, it did very well, but when it go into an intermittent operation, we had a lot of trouble. I think that right at that point I had better bring the diesel into the picture.

Now with the exceptions of these engines that I am talking about, the Winton Engine Co.'s business at that time, as it had always been, was purely builders of diesel engines, and they were right in the middle of that, and as probably as far advanced in diesel engine design of that period as any of the American builders.

Naturally we discussed among ourselves over and over and over again as to how we could make a diesel do this job, recognizing that with the increase in the price of fuel and the increase in horsepower, we had to find some way of taking advantage, if possible, of the high thermal efficiency of the diesel engine versus the gasoline engine.

I might state right here that at that time both of them operating under optimum conditions, the difference between the efficiency of one was about in the order of 18 percent in the gasoline engine and 36 to 37 percent efficiency in the diesel. I don't mean to say that that is what the efficiency is out at the rim of the wheels, I am talking about the engine per se.

Now another characteristic is this: that was vital, and I might add this, because it is going to come into the story somewhere along here, if I have a chance to cover the whole thing completely.

The diesel engine thermal efficiency characteristic or habit, if you will, is this: its efficiency curve or thermal efficiency curve is, so to speak, flat. In other words, idling with a very light load, not putting out any horsepower, it has the same thermal efficiency as it has at full horsepower. Now when we go to the autocycle or gasoline engine, as it is commonly known, which is the engine with the carburetor, spark plugs, and so forth and so on, the efficiency curve is what we call in the engineering world a drooping curve, that is to say that when the engine is idling, like when you are standing in your automobile waiting for a red light, the engine is at most inefficienct point on its efficiency curve. It is at the bottom.

And as you speed the engine up to horsepower and finally get clear up to its maximum power, it has its maximum economy, in other words, its maximum thermal efficiency.

Now in locomotives as well as in your automobile, there is the load factor, as we call it, involved. In other words, if you could run an engine full horsepower all the time for a given period or increment of time of 1 hour or whatever you want to call it, you would have a 100-percent load factor. You don't do that in your automobile or on

the streets, and so forth. Your load factor of the engine is in the order of 15 percent.

Now then, out on the railroad in these locomotives and in operation our load factors varied. We had discovered that the load factor in switching operation, that is, the locomotive built for switching cars, was in the order of from 15 to 30 percent. It varied depending on the assignment. When we got into passenger operation, it could vary some, but would normally be in the order of 60 percent. When we get into freight service, we can get it up into the 80-percent load factor.

Now, then, the gasoline engine operating on a relatively light load factor was a very inefficient animal because we were not working at the optimum efficient point, we were working way down the line. But the diesel engine, due to its inherent characteristics, when we put that in in place of the gasoline engine, we had a curve that was perfectly flat.

The engine is just as economical, thermally speaking, when it is idling or running at a 10-percent load or a 20-percent load as it is at a 100-percent load. So for the problem that we had to deal with here, which was purely an economic problem at all stages, purely an economic tool that we were dealing with, then we had to deal with something that had a fundamental optimum economic characteristic, and that was the diesel engine.

So naturally we struggled along to see if we could not produce among ourselves at Winton a diesel engine that was suitable for this job.

Mr. BURNS. Was that development of a diesel commenced before 1930 at Winton?

Mr. HAMILTON. Oh, yes. Winton at that time—I am still talking about the late twenties, 1928 and 1929—we commenced to recognize this problem, that we had one ahead of us, and we had to do something about it, and we started on the distillate experiments as a side issue, but it was there all the time as a problem.

Now the whole industry, the diesel industry in this country and in Europe, was working on this problem of doing this: reducing the horsepower weight ratio that had prevailed in the diesel engine development the world over at that time.

Those that had accomplished the most, some in this country, some in Europe, had finally got down to where they were willing to talk about and sell you an engine and guarantee it to have a reasonable commercial life that weighed in the order of 60 pounds to the horsepower.

Mr. BURNS. Was that a stationary engine or one that was on wheels.

Mr. HAMILTON. They seldom sold them for stationary. They were sold generally for boats in those times. That was primarily marine practice. There was no mobile power at that time I am talking about, with moderate exceptions.

There are some, and the story was given here yesterday, that is, as to the development of that character. But in principle, I am talking about the status of the diesel engine art at that time in this country and Europe.

Now it is true the Germans had built lighter weight diesels than that, had developed them for their submarines and our own people had them in this country and our own Navy had them.

And getting back to the point which we left on the shelf a while ago about Westinghouse coming into the picture in the late twenties, the Royal Automobile Society in England had taken a position that the English Government should support the development of a diesel-type or engine or a diesel cycle engine for lighter-than-air craft, and their experience with the Zeppelin bombing in England, which was only a scare, but they had it and they had not gotten over it yet after the First World War, so the Beardsmore people in England were commissioned by the Royal Society to develop a lightweight engine primarily intended for lighter-than-air craft..

Senator O'MAHONEY. Commissioned by the Royal Society?

Mr. HAMILTON. Yes.

Senator O'MAHONEY. With Government support?

Mr. HAMILTON. That is right. Now then, they made tremendous progress in building a diesel engine of relatively light weight. Now all the details of that I don't know, but it does not make too much difference, because the end result there that we are concerned with is this: That at one stage the Beardsmore people in their development felt they had a commercial product, and the Canadian National Railways in Canada decided to build some gas-electric cars and use an engine that Beardsmore would built following their development and experiment with this lightweight design.

Those engines were sent over to Canada by the Beardsmore people, and the cars were built in Canada, the electric equipment in this country, and sent up there, and the engines and the whole apparatus was installed by the Canadian National Railway in their own shop, and those cars were put in service.

Mr. BURNS. Was that gas electric or diesel electric?

Mr. HAMILTON. That is this Beardsmore diesel I am talking about. That engine weighed on the order, if my memory serves me, of about 15 pounds to the horsepower, instead of the 60 I was telling you about that prevailed the world over.

So shortly after that, after those cars went in service in Canada, the Westinghouse Electric Co. in this country made some sort of an arrangement with the Beardsmore people to build that engine in this country themselves, and they did.

They took on the manufacturing rights, or what have you, and they built the engine themselves, and sold quite a number in the form of a motorcar, 500 horsepower, and as I remember, the weight ratio of the engine was in the order of 15 pounds to the horsepower. They built quite a number of those, placed them in service on the different railroads in America at that time.

Now, they eventually quit that activity. Just exactly when they quit it, I can't recall right now. They quit it because it did not work out economically for some reason, and they decided to abandon the idea.

But that is the first introduction on any scale of consequence that I am familiar with of the diesel engine of the lightweight character in this country, so far as mobile power is concerned.

Mr. BURNS. Then in what period was that?

Mr. HAMILTON. That was 1927, 1928, 1930, in the late twenties.

Mr. BURNS. How did that compare to the weight ratio to horsepower of the gasoline engine which you were making and selling?

Mr. HAMILTON. Just about on that order, just about the same.

Mr. BURNS. Then they had solved one of the major problems as far as the use of a diesel engine on wheels is concerned?

Mr. HAMILTON. Yes, they had. There was one joker in it, though, apparently. The joker was this: That the engine was built by watchmakers apparently, and the minute something happened, the minute a piece failed and had to be replaced, you just about had to have that individual watchmaker on the job that built the first one the first time in order to get the engine back in shape.

That was the experience in Canada, and apparently, and this is an assumption on my part, but knowing the story, knowing the problem per se, apparently what happened was that when Westinghouse had to manufacture that engine, manufacture the pieces off of tools and with the standards of mechanical workmanship that we could normally employ in a factory, the engine was not a success.

For instance, I can recall in one circumstance being told by one of the officers of the Canadian National Railway that they had to send to England to get workmen to fit the pistons. They were not able to do it and they were lapped in by hand.

That means just the way a jeweler fits a bearing in a watch, the final operation is a lapping operation, and that is what they did, and it would take a man 2 days to put a new piston in 1 of these engines that failed, just to lap it in a little bit at a time, make a couple of movements, take it out, put it through a set of mikes, put it back in, put a little bit of emery dust on it, make 2 or 3 more movements, bring it out and go through that operation.

Now, it was an engine that required, it was so delicate, so highly designed that it required some sort of workmanship to function. When they tried to make it on tools it became an impossibility. It did not function. It was erratic, didn't stay together. Pieces would fail, so I am sure that is the reason why Westinghouse decided it was not a commercial proposition.

Mr. BURNS. But at that point, from the scientific standpoint, they had solved the problem?

Mr. HAMILTON. That's right.

Mr. BURNS. Of making——

Mr. HAMILTON. It could be done. But on the other hand, the Germans were making a 10-pound engine before that, but they were doing the same thing. It was so involved with so many auxiliary "gadgets" and such refined workmanship and design that to manufacture it at any reasonable price—the way to make things in America—it was an impossibility.

The Germans could do it with endless craftsmen of every character and a relatively low cost per hour, and men that had spent their lives at one individual job, why, they could build it, but we could not build it in this country that way.

So the Germans had a 10-pound engine even then, but that was about as nice a job that I know of that was done by anybody at that stage.

In this country to build an engine that would live on the railroads or in the kind of service that we are talking about, anybody's engine, I don't think there was any exception to that rule including Winton; the best you could do was in order of 60 pounds to the horsepower in 1928, 1929, and 1930.

And there was another factor in there, too, and that was the crankshaft speed. The fastest running engines in that period were in the neighborhood of 400 to 450 revolutions a minute. That was ideal for boats because you want a slow propeller operation, anyway, so there was no great problem there.

But when it came to our business where we were running a generator and the weight of a generator is in inverse proportion to its speed, revolutions, so to speak, in other words, if you run it 450 revolutions a minute it will weigh, we will say, a thousand pounds—that is not so, but then that is relative. And if you double up the speed to 800 revolutions then you can make a generator at 500 pounds that would have the same capacity.

So when we talk about a generator delivering a lot of horsepower, turning over at 450 revolutions, you are talking about a machine that weighs more and costs more than the whole engine itself. So that was not practical in our book.

It was in our estimate that we had to have speeds of 800 revolutions or more to make a successful electric transmission, in view of the weight factor involved.

So we decided at that time, Winton and ourselves, that we would take one of their engines and experiment with it. So we took a marine engine and tried it out and found that all the factors that we knew on paper were so. The next step was this: we took 1 of our 8-cylinder 400-horsepower gasoline engines and converted that into a diesel and rated the horsepower back to 300 as against this normal rating of 400, and we put that out in a switch engine and tested it for about 90 days or 6 months, I guess, altogether on a railroad in Cleveland, and found out a lot of things.

We found out two things were wrong. One is that the injection system, that is, the means of putting fuel into the engine, which is simply a pump with a lot of pipes and valves and so forth, operating with a camshaft that squirts a little oil in the cylinder at the right time when the engine is running, that is the means of supplying the fuel on diesel engines, that that mechanism was not as developed at that time in the history of the whole industry, and the mechanism we used was built by the Vickers people in England, who were the leading designers of the so-called diesel injection system at that period, that it would not do the job because it was erratic in operation.

We could not get them so tuned up so that you would get an even explosion throughout the engine at all times. One cylinder would have more fuel than the next. The result was we put a twisting and winding motion on the crankshaft and pretty soon the engine came apart. That was one trouble.

The other trouble is that the tubes and pipes and all the other things that carried this fuel under such high pressure, 6,000 or 7,000 pounds to the square inch, would not live. And at that time nobody knew how to make tubes and joints.

We did not have the metallurgy that we have today, so the result was we had leaky pipes and joints after we had the locomotive in service where you got a lot of vibration coupling in the boxcars, you get shaken up and so forth, and every time you would do that you would snap off one of these pipes that had 7,000 pounds of pressure in it. They were made out of material that would not take it.

So we decided at that stage that the answer was we had to develop an entirely new injection system, start at scratch, if we were going to make it.

Then after we got that done, we had to learn how to make the rest of the structure, and we had to reduce the weight if we were going to have a commercial engine, from about 60 pounds to the horsepower down to 20, which seemed a fantastic program.

Anybody that remembers the newspapers telling us all about it in those days of the problem of getting the weight of the internal-combustion engine down for airplane service, a long pull getting it down from 6 or 7 pounds to the horsepower to 2—eventually we got it down to a fraction of 1, but there were years involved there.

Now we are talking about the same problem, only we are talking about taking an engine that weighs 60 pounds and bringing it down to 20, and to double its speed and at the same time increase its life, its useful life of the parts. That was the problem that faced us in 1930.

Naturally we knew—we sent engineers to Europe to see what was going on over there and they brought back their stories.

And here and there you would find a little information, somebody had done something over there, and we put those things together to see what kind of a picture it made. We finally came to this conclusion, I did, anyway, that the development was clear out into the pure research field to get over the barriers. There was nothing known, nobody had done anything specific that you could combine together and accomplish the objective yet. We had to go clear and far afield.

We had to learn to build a structure for the engine that would take 2 and 3 times the stress that we were using at that time. We had to develop bearing materials that would carry bearing loading, in other words, pressure per square inch way out beyond what was being used successfully at that time even in the airplane world, for that matter.

We had to develop valves that would stand the higher temperature condition than we had before and pistons that would have to stand it because the engine had to be small, if it was going to be light, and if it was small that meant each cylinder had to do more work, the heat was going to be greater. So we had to work in the realm of temperature ranges in pistons that nobody had been working in before.

Well, on top of that, we had to evolve an injection system, new from the ground up. I came to the conclusion on my own—and I won't say that if Mr. Codrington was here today he would support me entirely, because his concept was a little different from mine, but this was mine—that where we stood at that time, it would cost in the order—and that was simply a figure taken out of the air, Mr. Senator, there was no place else to get it—about $5 million in the engineering development to learn how to make the kind of an engine suitable for this job that we were talking about.

Now, if we learned how with $5 million, then there would come the capital required to tool up to manufacture, because the experience of Beardsmore, or Westinghouse with the Beardsmore engine, the experience in Europe trying to build in any other shop except the original shop the little German diesel that was used in our submarines, taught us definitely and specifically that if you can't build something that is well enough designed initially, fundamentally that you can

manufacture from tools, jigs, and fixtures, then you had better not tackle it.

Now, it could be done. I will point out another story here. I am going far afield, Mr. Burns. I hope I am not getting this too involved, but I want to point out one thing to make my point on that right there.

The first exhibition of what can be done on tools that I am aware of definitely, by making things on tools that can be uniform and one piece fits where the other fits regardless of whether it was originally installed there or not, was after the war and the English Royal Society again ran this sort of an examination.

Among other things, there were a lot of tests at that time of products that were developed during the war, French vehicles of all kinds and English vehicles and ours, and so on, airplane engines, and all that.

Among the things they did then and that astounded them was this: we had in Europe a lot of staff cars, a lot of them at that time, and those staff cars were Cadillac 8-cylinder engines. I had nothing to do with General Motors in those days, so I am not ringing a bell for General Motors.

Mr. BURNS. This is after the First World War?

Mr. HAMILTON. This is after the First World War; 1919 I am talking about now.

Cadillac had introduced an 8-cylinder engine in 1915 in their automobile. That was their first jump from the old 4-cylinder engine. And at the time they built that engine, they had tooled up to manufacture, make all pieces alike and absolutely interchangeable to a maximum and minimum tolerance that nobody had ever thought of as being possible and practical in pieces that big.

Now, we do it in watches and we do it in adding machines, and we did it in typewriters and cash registers to some extent, but nothing in those things has any hard work to do, so it doesn't mean too much. Here we are talking about something that has got to work hard.

So the Automobile Society of England didn't feel that the stories they got about these machines being built on a production basis, all the pieces being built on a production basis, all the cars assembled out of one bin of pieces by a flock of mechanics at the other end of the plant, they didn't believe that story.

So what happened was they took 2 cars, tore down the engines completely and mixed up all the pieces, just scattered them around in a pile, and then they brought in a mechanic, turned him loose and asked him to assemble the 2 engines, which was done.

When they got the engines assembled, they took them over and put then on the test stand, each one of them went right up in horsepower to its norm.

Senator O'MAHONEY. The triumph of standardization.

Mr. HAMILTON. Exactly. Now, then, getting around to our problem here in 1930, we knew we had to design an engine that had the physical characteristics that I am telling you about. It had to have 800 turns, or better, in speed, it couldn't weigh over 20 pounds to the horsepower, and it had to have X life.

To do that, we had to manufacture it on tools. And I said $5 million to design it, and maybe another $5 million to build the tools and equipment to manufacture it. So it was a $10 million project, as we saw it.

We didn't have $10 million. In fact, I doubt whether there was $10 million of venture capital in the whole diesel industry at that time, I am talking about venture capital, willing to take on a project so farfetched as that.

The proof of that is that Codrington of Winton Co. said: "You are shooting for the moon. If you do half that well, it will take us a few years. You can still run a locomotive with it."

We said, "No, that is only going halfway in, there is no use of doing this halfway. If you can't go all the way in, you had better not start." So that is where we stood.

Now, when 1930 came on, as we all know what happened to the businesses of the country that followed the stock market crash in the fall of 1929, Winton's business was pretty badly shot, our business was zero, and we were stymied with this problem of not having a product that the railroads were interested in buying.

They said, "We want bigger horsepower, we will take 1,500 horsepower, 2,000 horsepower, to haul all these trains and do all these things, if you come up with enough engine and it has economic possibilities," and there she sat.

So at that stage—and I am not familiar as to how this came about because I had nothing to do with it—at about that stage in time, the Winton Engine Co. was building some diesel engines for yachts for officers of the General Motors Corp. In fact, I think there were 4 of them involved at that time, 4 boats involved.

The result was a lot of contact back and forth between the management of the Winton Engine Co. and the General Motors people, because these were all topflight officers of the corporation that were buying these boats. Now, that went on for quite a period of time, and these engines finally got in process of manufacture.

Now, during that period Codrington told me one day, he said, "You know, you and I have talked a lot about how we are going to solve a lot of our problems." Now, during this period of trying to decide how we were going to solve our problems—and that meant getting capital into the business somewhere, somehow, and capital that would not completely control us and dominate us—we had examined all of the engine builders with the idea that we might consolidate 1 or 2 of them, or do some other thing and get a situation in motion where we could get the capital and go ahead with our engine development.

Senator O'MAHONEY. This is capital that wouldn't control?

Mr. HAMILTON. That's right; capital that wouldn't control, so that we could still manage the business and carry the project that we were shooting for, carry it on.

We decided that didn't exist among the diesel-engine builders at that time. We were quite familiar with the engineering ability and the mental attitude of nearly all of the major companies. We had relations with them, one way or another. So we were at our wits end.

We did not know at that stage what to do about it, until finally Codrington said to me, "There is a possibility that the General Motors people would be interested in buying the Winton Engine Co."

At that point he and I sat down and took a long look as to what would happen to us and what that might lead to if they did that, thinking entirely in terms of our development program, how we wanted to expand, and particularly as related to the railroad end.

because we were the largest customer they had, and it was quite important to Winton in the volume of business.

We took a long look at that one, and decided that, well, after all, General Motors has what we need. We need tremendous research facilities in the form of talent and laboratories, with all of the necessary instrumentation and all of the apparatus for testing, clear on out into pure research, if necessary. They had plenty of capital, they are in the habit of doing things of that kind. That is the way they had evolved their automobile.

So on the surface, it looked like the right kind of people to be tied up with. It depends, as I saw it and as I said then, on their attitude.

Now, you would be talking to them about heavy industry and something they are not accustomed to, when you talk about big engines and stuff on the railroad, and it won't be a volume business, they may turn you down. You may scare them when you tell them what sort of business this is. But if they go along, why, it will be a natural.

Well, that is what happened. They did go along. What Codrington said to them, who started the thing, whether it was General Motors or some individual in General Motors, or whether it started over banter or how it got going, I don't know. I don't know anything about that. I wasn't involved. I just heard the story.

The only point that I can contribute there that is definite and factual is that after General Motors had made a deal and they had bought the Winton Engine Co. and owned it, and they had made it a subsidiary. From that point on, of course, we were dealing then with a subsidiary of General Motors, that is, Winton Engine. Codrington and staff, and everybody, remained the same. There was no change in personnel.

I, of course, was delighted, because I thought, "All is right." In the meantime, I had got acquainted with Mr. Kettering. He had been back and forth. In fact, one of the boats being built involved his boat, and two of the engines built there were for his engine, for his boat, so I saw a lot of Mr. Kettering. I never knew him up until that time.

Mr. BURNS. Is this before or after GM bought Winton that you met Mr. Kettering?

Mr. HAMILTON. I think I met him before that, but if so, it was at a lunch or something, because I had no business with him, and I can't say that I talked to him specifically.

We may have had offhand conversations. But it became serious as soon as Winton was taken over, then he was there, and we had lots of long talks and I commenced to shape up and tell him then what our problem was in our business, just where we had become stymied and why.

Senator O'MAHONEY. You have told us about the negotiations which Mr. Codrington suggested——

Mr. HAMILTON. Which he suggested to me.

Senator O'MAHONEY. Yes; for the sale to General Motors?

Mr. HAMILTON. Yes.

Senator O'MAHONEY. That was the sale of Winton?

Mr. HAMILTON. That's right.

Senator O'MAHONEY. What about Electro-Motive?

Mr. HAMILTON. I am leading up to that, Mr. Senator. It follows right along there.

Senator O'MAHONEY. Off the record.

(Discussion off the record.)

Senator O'MAHONEY. Back on the record.

Since you have referred to Dr. Kettering, I want to say for the record that today I have received the best lecture on technology that I have heard since Dr. Kettering testified before the TNEC, of which I was the chairman. You have developed your facts in a very orderly manner.

You have shown how important it has become in the field of technology to turn from the lapping operation to the standardization operation, in order to produce the volume and the kind of machines that were required.

Now, perhaps to illustrate why this committee is in session, I want to say merely this: that the human question is whether it is necessary to standarize human beings as well as machines to obtain the sort of technological progress that we need and the sort of society, free society, which has been the aim and objective of all political thinkers in this country since the very beginning, and which is now the aim of our international policy with respect to international society.

It is the machine versus the man, the machine in the political field and international field being the Communist society or the Fascist society, the man being the individual human person who should be permitted, who should be free, if our ideals are to be carried out, to rise above the machine.

I am very pleased indeed, Mr. Hamilton, that you have been with us this morning, and I think our session this afternoon will also be productive of good results.

Mr. HAMILTON. Thank you, Senator.

Senator O'MAHONEY. The committee will stand in recess until 1:45.

(Whereupon, at 12 noon, the subcommittee recessed, to reconvene at 1:45 p. m. of the same day.)

AFTERNOON SESSION

Senator O'MAHONEY. Mr. Burns, are you ready to proceed?

Mr. BURNS. Yes, Senator.

Senator O'MAHONEY. You may proceed.

STATEMENT OF HAROLD L. HAMILTON, ACCOMPANIED BY HENRY M. HOGAN—Resumed

Mr. BURNS. Mr. Hamilton, do you recall at what point you were when we recessed? Do you want to commence from there?

Mr. HAMILTON. Yes. I think it is well to do that.

Mr. BURNS. Yes.

Mr. HAMILTON. We were at the point where General Motors Corp. had acquired the Winton Co., but no negotiations as yet had been started in connection with Electro-Motive Corp. being acquired.

Now, before I get into that point, there was a gap in the story there if it is not brought into the picture at this point, which will not be easy for me to explain just exactly why the final decisions were made by Electro-Motive people to join up with the Winton and the General Motors group.

Senator O'MAHONEY. May I suggest that it would be helpful now if you would tell us who the executives were in each group, in Winton and Electro-Motive at this time.

Mr. HOGAN. This is 1930.

Senator O'MAHONEY. Yes.

Mr. HOGAN. After the Winton acquisition.

Mr. HAMILTON. Well, my memory may be, so far as the Winton group is concerned, a little hazy.

Senator O'MAHONEY. Well, you can clarify that for the record afterward if you desire.

Mr. HAMILTON. Mr. Codrington was president of the Winton Co.; and a man by the name of Freiberger, I think, of the Cleveland Trust Co., was a director and also an officer, as I recall it, and a man by the name of McKinstry was secretary, but I cannot at this moment give you the names of the balance of the directors. I do not remember who they are.

Senator O'MAHONEY. It will be possible to find that out, of course.

Mr. HAMILTON. That information is available, but I just do not happen to recall.

Senator O'MAHONEY. Were they associated with any other similar enterprises?

Mr. HAMILTON. No. In fact, I am quite certain that most all of them, the people in the financial world, all the balance of the directors, and one of those, Freiberger, was the Cleveland Trust man—I think all the rest of them were financial people, if my memory serves me correctly.

Senator O'MAHONEY. Well, we can get that very easily

Mr. HAMILTON. But I would not make that positive.

Senator O'MAHONEY. With respect to Electro-Motive?

Mr. HAMILTON. In that case, I was president of the company, and we did not have a vice president at that time. He had died shortly before. A man by the name of Peddler was secretary and treasurer.

As directors we had a man by the name of Blythe, who was a member of the firm of Ernst & Ernst; a man by the name of Nelson who was an officer of the Union Trust Co.; a man by the name of Jeffers who was—I do not know whether he was an officer or not, but he was connected with the Aluminum Company of America. How many have I named? I do not remember now.

Senator O'MAHONEY. It is not necessary to tax your memory.

Mr. HAMILTON. That is about as far as I can go at the moment.

We had several deaths among our stockholders—that was at the end of the twenties—and those men had been directors; and when those men stepped out, we brought in bank people because of the estates.

Senator O'MAHONEY. How much stock was outstanding in Winton?

Mr. HAMILTON. I cannot tell you that; I do not know their financial structure.

Senator O'MAHONEY. How about Electro-Motive?

Mr. HAMILTON. Well, there was—meaning shares or in dollars, or how do you mean how much was outstanding?

Senator O'MAHONEY. Well, in shares and the par value of the shares.

Mr. HAMILTON. Well, there were about, as I recall it, 13,000 shares which had been issued a that time.

Senator O'MAHONEY. Who had control?

Mr. HAMILTON. I had the largest block of stock, and the control was in the hands of no one individual. There were several groups that controlled it, if they added theirs to mine, but there was no individual that had control.

Senator O'MAHONEY. What was the value of the stock at this time?

Mr. HAMILTON. In the order of $100 a share.

Senator O'MAHONEY. Thank you, sir.

Mr. BURNS. Will you continue.

Mr. HAMILTON. We were talking about the period in the summer of 1930.

Now, in order to establish our state of mind and why we decided to go along with eventually joining up with General Motors: There was another development that had run along somewhat parallel to ours. It had started back in 1924 and 1925, 1925, I think, really, and that consisted of an arrangement or a working arrangement between three companies, one of them being one of the major locomotive builders, and they worked out a program and built a small, what they called, switching locomotive, and it had a diesel engine in it supplied by one of the group.

Mr. BURNS. Which companies were those?

Mr. HAMILTON. Those were the Ingersoll-Rand, General Electric Co., and the American Locomotive Co.

They built, first, a small switching engine, and it, in principle, other than the fact that it had a diesel engine, small diesel engine in horsepower, it followed the same general practice and had all the same characteristics of the motorcars that we, rail motorcars that we, were building.

In fact, the people who did the layout and the design were the same group of engineers in the General Electric Co. at Erie that had worked quite along with us, so all they were doing was just starting off on this same track.

Throughout the balance of the twenties, from that time on, 1925 until, we will say, 1930, that group of companies, together with 1 or 2 others—I cannot go into too much detail on that—including the Westinghouse Co., with their engineers, built a variety of diesel switchers and sold them for specialized purposes.

Now, apparently the initial application of those locomotives was largely in a specialized application. They were used where smoke ordinances had come into play, for instance, like in Chicago, being one case.

They were used where industry had a fire problem or where they had cars inside of a building, like the Merchandise Mart in Chicago: the railroads had them there because they could run under the building without steaming and smoking up the place and introducing a fire hazard.

Quite a number of them were used over the country in that general way.

The first engine was 300 horsepower, a rating of 300; the locomotive weighed 60 tons.

Now, following that, they eventually built engines up to as high as 600, as I recall it, horsepower, and built larger locomotives of similar character, and the locomotives weighed more, and so on.

There were quite a number of those in service by 1930 in different parts of America.

Now, I watched that development very carefully. I used to go and ride those locomotives occasionally when I was some place where some railroad had one that we knew it well, and we would ride it, and get the feel of its performance, because I had a feeling then that they were on the right track, and I was curious to know what the mechanical makeup of the jobs that they had done were, and so on.

Riding the locomotives and talking to the railroad people at that time, I learned what their complaints were, that is, why they seemed to be limited in their enthusiasm as to their possibilities of a successful commercial product and as a good piece of motor power on the railroad.

So I thought I knew what was wrong in the minds of railroad people. So we decided to see if we could not do something to find out whether our judgment was right.

Therefore we built a small—2 or 3, in fact—switch engines weighing in the same category, about 60, 65 tons, and we put a 400-horsepower gasoline engine in them, and they were sold to one of our eastern railroads, so we had a chance to see what happened when we had about the same kind of a locomotive as the other people were building at that time.

We did not consider ourselves competitive at all, but we had this locomotive with that type of an engine in it.

Mr. BURNS. This was before you were taken over by General Motors?

Mr. HAMILTON. This is along about 1927 I am talking about because it is a development which ran parallel.

Mr. BURNS. Yes.

Mr. HAMILTON. Then we also built, for one of the western railroads, a locomotive with 2 of our 400-horsepower engines in it, 800 horsepower, and they were used for the line operation, and freight service hauling up to 30, 40 cars. When they were not out on the main line or out on the branch line, they used them in the yard for switching purposes, so we had a chance to ride them and see what happened.

One of the things that the railroads apparently did not like about the diesel of that period was their sluggishness, their inability to do other than to push cars around.

They did not, apparently, have the acceleration or the pickup, as we call it in the automobile world, that they needed and required if the engine was going to be used in yard service and general switching, particularly where they break up cars and kick them down the track. They wanted something that has got some action to it.

So they would say to me, "Fine, but we can take one of these little six-wheel steam engines out here that does not weigh any more on the drivers than that locomotive and do twice the work in the same number of hours here in the yard as we can do with that?

"If you want to push a lot of cars up the coal chute or where the adhesion is bad or the curves or grades are bad, then the diesel has got it, because they will lay down and pull all that is loose in the yard. But when it comes to fast movement they are out."

I thought I knew the reason for that, but I was not sure. But after we built these locomotives I am talking about, with the gasoline engine, we found out quickly that we were right.

What happened was that the diesel engine, due to the nature of the design at that time, big heavy pistons, big heavy rods, big heavy crankshaft, slow turning, big armature at the end of the crankshaft, the inertia forces of that rotating mass were so heavy that when you opened the throttle it took that engine a long time to get itself wound up to where it could deliver its power to the drivers. In the meantime, the engineer was disgusted with it because all he could do was shove cars really; he could not kick them. That was, in effect, what was wrong.

When we put the gasoline engine in there, we had an engine that had quick acceleration more like an automobile engine. You open the throttle, and it is up to speed right away, so you could kick cars up to the limit of the weight on the drivers; all that was controlling the acceleration was adhesion.

It would kick cars, and the 800 horsepower we had on the other railroads, it was a lively switch engine, very useful. So I had made up my mind there that Electro-Motive, including Winton, were not in a position to build an engine at that time, a diesel engine, any better than what these people were using. Ours was at the same point so far as technological characteristics are concerned. The rods were heavy, the pistons were heavy, and the shaft was heavy. The pistons were slow.

So we could not do any better than they were doing, and it was not in the book at that stage for us to go into the switch-engine business. That is what it added up to, because we did not have an engine. We could not do any better than they were doing, and the railroads would only buy them for specialized application.

Further proof of that point, I think, is this: Now I am dealing with memory, and I do not want to be pinned down as to absolute dates, but up to that time I think probably the largest order ever placed for a locomotive or what would be called a locomotive involving an internal combustion engine was by the New York Central Railroad, as I recall it, and it was the result of ordinances passed around New York excluding the use of steam locomotives in certain areas.

To meet those requirements, the railroad, in conjunction with several builders, being the New York Central, I think their historic relationship was American Locomotive, so I am sure it was the American Locomotive and GE, and one of the big battery companies—here is what they did: they built a locomotive in which was primarily a tremendous storage battery. All the other characteristics were the same.

It had trucks on it, it had a cab on the top, and the cab was loaded with immense storage batteries, and they put a diesel motor and generator to charge the batteries, so that the engine ran at constant speed, delivering horsepower all the time, building up the capacity in this battery, and inasmuch as the job to be done in these particular isolated spots around Manhatan, the Manhattan area, was one in which they needed a lot of horsepower when they were working, they did not work very long, but when they did work they wanted lots of horsepower, so this little engine was busy churning along, charging these batteries, and when they were ready to go to work they had lots of horsepower, they could kick cars and move cars, and do the job quickly and fast and sharp.

Now, there were 52 of those. That was, by far, as I recall it now, the biggest order, by far, up to that time placed.

But it proved the point I am telling you; I am telling you that tale to prove the point I am after here, and that is there was not anybody in this country apparently who knew how to build a diesel engine that would make a good switching locomotive at that time, and that included ourselves and Winton and all the rest of them. We could not have done any better than the boys that did the other job.

Now, that helps to establish the state of mind of Electro-Motive in the fall of 1930 when Mr. Codrington came to me and he said, "You know, while you think you are in a pretty nice position, you still have got a good source of supply for engines, and we are going to go places in the development of a new engine, I think it may be we might induce or General Motors might be interested in taking Electro-Motive into the picture, and we would all be in the same family."

Well, it is true enough that the economic conditions at the time were bad. We know we were in the thirties, and we were still on our way down. The future was an uncertain and unknown quantity.

Electro-Motive was in a very healthy position. We had built up a substantial reserve, but 2 or 3 or 4 years without any business would be quite a drain, and I was not sure the depression was going to end any faster, and on top of that the question was what have we got to sell. We did not have anything to sell. That is what it added up to.

In the meantime, I had been talking with Mr. Kettering, and he and I had many talks together with our feet up on the chair some place thrashing around the problems that went along in doing the job we were talking about, taking the weight out of the diesel and reducing the weight of the reciprocating parts and getting some snap to it, and furthermore getting some life into these parts, something that would live a while, and not have to put new bearings into it every 90 days, and all that kind of thing.

So I was receptive to what George, Mr. Codrington, was talking about.

I talked it over with our people. We went over all the phases of it, and we were a closed corporation—there was no stock on the market, it was just a few of us who owned it—so we finally agreed that we might go along.

Eventually Codrington came around and asked me, "How much do you want?"

So we talked that one over and decided what we wanted, and in due course a meeting was arranged in Detroit. I had a long talk with the vice president of the corporation who was handling the matter at that time, and we came to an agreement, and there was a stock exchange that took place.

Senator O'MAHONEY. What was Mr. Codrington's position at that time?

Mr. HAMILTON. He was president of the Winton Engine Co., and the Winton Engine Co. at this time was a wholly owned subsidiary of General Motors, its purchase having occurred in June, and the period I am talking about was later the same year.

So that we went into the group, as we called it, in the latter part of December of that same year, 1930, and became a part of it, and again a wholly owned subsidiary, with no relation to the Winton Co. at all, except the fact that all the stock was owned by General Motors in both cases.

Mr. BURNS. At the time that Winton became a subsidiary of General Motors, was it making any diesel engines at all for any purposes outside of those for the yachts, those special jobs?

Mr. HAMILTON. Well, their engine fit into quite a few applications, but nearly all of them were marine, tugs, and yachts and small fishing boats and things of that kind.

Mr. BURNS. So they were making diesels?

Mr. HAMILTON. Oh, yes. They had a long line of them. They probably were the biggest line, that is, in size, horsepower, and different characteristics, as big a line, if not the biggest, in America at that time, variety, I should say, to pick from.

Mr. BURNS. Were they then one of the largest engine-manufacturing companies in America at the time?

Mr. HAMILTON. Well, they were—I do not know—there were not any of them very big—but they were up where they were doing, I think the volume of business, was probably about equal with any of them.

I do not know any of them who were any larger, who had any larger volume than Winton. They were all about the same category.

Senator O'MAHONEY. Were diesels being used for anything beside these marine uses of which you have spoken?

Mr. HAMILTON. Oh, yes; oh, yes. The Winton Co. had more or less picked on the marine because they were always working toward a lighter engine with more crankshaft speed, and they were looking for applications for that type of an engine.

Now, most of the big diesel builders, engine builders, of that period built engines for stationary application, which were still larger and still heavier. Some of them went up into the three, four thousand horsepower range, but they were big engines, weighed 200, 225 pounds to the horsepower.

Senator O'MAHONEY. But they were not locomotives? They were not locomotive engines?

Mr. HAMILTON. Not at all. They fit big ships, big central power stations, and pumping stations, and where they set on a foundation or had a ship or something to ride in, where size and weight were not of such an important factor.

Senator O'MAHONEY. Have any of the names of the corporations engaged in the building of such engines as you have now described been mentioned in these hearings?

Mr. HAMILTON. Yes, one of them; McIntosh-Seymour.

They are now, I think—I do not know just what the arrangement is—but my understanding is that American Locomotive bought that company some years back; they own it. Whether they have dissolved it or what they have done with it, I do not know, but it was a very old-established engine.

They were steam-engine builders in the old days when they built steam engines, stationary engines, and then they went into the diesel, made big engines; one of the very fine old engine-building plants in America. They might probably be said—they probably built the finest Corliss steam engine that we ever had in this country.

Senator O'MAHONEY. Are those stationary still being built, diesel stationary?

Mr. HAMILTON. Oh, yes.

Senator O'MAHONEY. And not by General Motors?

Mr. HAMILTON. Not by General Motors, no.

We do not build for that, but there are many engine builders in the country that build big engines, and very effective engines.

I think our industry is far ahead of the Germans or any of the Europeans.

Senator O'MAHONEY. How many such companies are there; would you say?

Mr. HAMILTON. Oh, right now there are probably 5 or 6; there might be more than that.

Senator O'MAHONEY. They are not involved in the locomotive field at all?

Mr. HAMILTON. No.

Senator O'MAHONEY. Thank you.

Mr. BURNS. At the time, in 1930, what was the lowest weight-to-horsepower ratio diesel that Winton was making for any purpose?

Mr. HAMILTON. Well, that is a flexible thing, you see. If you build an engine, in other words, you build an engine, and an engine's life, a diesel engine or any other engine's life, is based on what we call mean effects of pressure; in other words, the amount of work it has to do.

If you have a job where the load factor is light, the amount of work is just a few peaks in it, then you can rate it higher in that application than you could if it had a constant heavy-duty job to do all the time.

But across the board, the average in Winton varied between 45 and 60 pounds to the horsepower.

Mr. BURNS. What weight ratio did they use in these diesels that were put into the submarines?

Mr. HAMILTON. Well, that is the next step, but the German engine, as I recall, it weighed in the order of about 15, 18 pounds to the horsepower.

Mr. BURNS. Were not any of those put in American submarines prior to 1930?

Mr. HAMILTON. It was my understanding that nearly all of them were; all of our submarines had them.

Mr. BURNS. Those that were made by American manufacturers?

Mr. HAMILTON. No, they were—I am not sure whether any American manufacturers made any of those engines or not, but they were of German design. I cannot be sure now. I would not take a position on that. They could be—it could be that some American manufacturers made some of those engines, based on German designs, but I cannot answer that one.

Mr. BURNS. Those were comparatively low-weight ratios?

Mr. HAMILTON. They were very low-weight ratios, very complicated, full of all kinds of gear and almost impossible to manufacture them, very delicate and full of headaches no end, because particularly of the piping and the outside design of them, with all the high pressures running around in pipes so that they were a headache in the Navy, and dangerous to the Navy.

That is the reason why some of the other things that will come out here later, may come out here later, got into this picture.

Mr. BURNS. You stated previously that you were, perhaps, the largest customer of Winton. Did that cease around 1930 when you had these problems of selling to railroads when the cost of gasoline went up? Did you lose that position for a temporary period?

Mr. HAMILTON. As being the largest customer?

Mr. BURNS. Yes.

Mr. HAMILTON. Well, I would say probably so. I think that 1929 was the end of the motorcar business really from any volume standpoint of any consequence, but it was likewise somewhat the dropping off point in the marine business, so far as Winton was concerned.

Now, we had some deliveries in 1930—I have forgotten what they were—and Winton had some business in the thirties. Now what happened percentagewise right there I do not know; I could not tell you.

Mr. BURNS. During the few months after Winton became part of General Motors, up to the time when Electro-Motive also became part of General Motors, were you purchasing any engines from Winton?

Mr. HAMILTON. Oh, I think there were a few; there were a few motor cars being built at that time; we were buying some, yes.

Mr. BURNS. But your commercial activity was slowed during that period?

Mr. HAMILTON. Very very slow.

Mr. BURNS. At that time was General Motors making any diesels of any type that you know of?

Mr. HAMILTON. No; they were not. General Motors at that time. based on my conversations with Kettering—he had been thinking seriously along the lines of the diesel cycle as per se, not an engine or its application, but the diesel cycle per se, and that is the subject of our conversations of great length, so they had been thinking about it, talking about it among themselves, and I think he had run some experimental phases on certain parts of the problem; but there had been no manufacture of diesels. They did not have any design even at that time.

Mr. BURNS. At the time that Electro-Motive became a subsidiary of General Motors, the extent of the development of a diesel locomotive was the extent to which your company and Winton had been endeavoring to develop a combination of the diesel engine with the electric transmission of this low-weight ratio?

Mr. HAMILTON. We were stymied right there. We did not know—we knew, and I said that before this morning, and I will repeat again—our experience proved that so far as rail motorcars, and we could project the problems right on out into any sizes that we wanted to consider, there were a few fundamental laws involved there, that the prime mover, in other words, the engine, had to be limited in the order of 20 to 22, 25 pounds to the horsepower, in that bracket, to produce what we would consider to be a commercial product, and it had to have a few other characteristics, including this quick acceleration if we were going to build a switch engine, successful switch engine, that the railroads would buy and would consider as being an economic tool.

The ones they were running, they did not consider an economic tool: they were just a convenience.

Mr. BURNS. Now, what your company sold to General Motors was its stock, and this became a subsidiary; is that right?

Mr. HAMILTON. It was a stock exchange.

Mr. BURNS. Yes.

Mr. HAMILTON. We took General Motors stock for our stock.

Mr. BURNS. I see.

What was the sales price upon which the exchange was based?

Mr. HAMILTON. Somewhere around $95 a share, I think, for Electro-Motive, and about $45 a share for General Motors at that time. That was the market price.

Mr. BURNS. Then you had about 13,000 shares at that time of Electro-Motive?

Mr. HAMILTON. Yes.

Mr. BURNS. Was there any understanding as to what further development would be sought by having your company and Winton together in the General Motors organization? Did you have a specific program which may have been the reason why you sold your stock or exchanged your stock and joined up with the General Motors organization?

Mr. HAMILTON. Well, we did not have it on paper. Everybody involved understood what the problem was at that time. That problem had been made perfectly clear, and I think if the facts were known I think the fact that there was such a problem of that kind existing right then, and at the time so intrigued Mr. Kettering, that he wanted to get right in the middle of that one, right now, and I presume that his influence on General Motors entered into their decision to put all these things together and really get at this job, because up to that point he had been thinking in terms of purely the scientific or technological problems and the technical problems, unknown problems engineering-wise to do to a diesel what had to have done with it.

That was the extent of his thinking. Here we come along and here is the problem. We are waiting, we are stymied. All we need now is an engine that will meet these specifications.

So the minute we fed him that it was just like ringing a bell to a fire horse; he wanted to get into that act quick, and, of course, that encouraged me, and there were further conversations, as I recall it, with the officer in General Motors that I carried on my negotiations, in which all the things were laid out on paper, and we made it clear that we did not have any business.

He knew that. The records were there, he could see what was happening. Winton did not have any business, but none of us thought the country was coming to an end. We felt there was a future for us.

We knew we had an economic potential that was just opening up like a rose once we could get over some of these hurdles, and the hurdles were challenges to General Motors research people, and they were anxious to take hold of it, and I am sure Mr. Kettering assured the General Motors people there was no question but what we could do it.

It might take some time and dollars, but we could do it if we could get over this hurdle; but that is where it sat.

Mr. BURNS. It appeared to you that Mr. Kettering was keenly interested in the scientific phases of developing and improving a diesel engine?

Mr. HAMILTON. No question about it. We spent hour after hour and night after night talking about it.

Mr. BURNS. And what you offered was this prospect of a specific application?

Mr. HAMILTON. That is right.

Mr. BURNS. And as you felt, a specific market in case you succeeded?

Mr. HAMILTON. That is right. That is what we offered.

And I recall very definitely the officer I was dealing with at General Motors, after talking about these details, he turned and said, "Now, here, you don't own anything; you have a quarter of a million dollars in spare parts and the rest of all cash. Just what are we doing buying this outfit?"

And I said to him, then, I said, "You are buying some know-how, the potential base from which, with what you can add here and what you can supply, tying it all together we can establish a new industry." He agreed with that, and he—he agreed with that.

Mr. BURNS. I gained the impression from what you said up to now that you had been the prime mover in this development, at least as far as you and Winton were concerned?

Mr. HAMILTON. Right.

Mr. BURNS. And you were bringing to General Motors all that background and thinking which you had gone through.

Now, were there any others in your organization who, besides yourself, contributed to that development or were they all just working under your structure?

Mr. HAMILTON. We had a staff of people. We had electrical engineers, a chief engineer, a man named Dillworth, and a book has been written about him. He was probably one of the leading engineers, particularly in this field, recognized in America. He was chief engineer of Electro-Motive. We had a substantial staff of people.

Mr. BURNS. You had a substantial staff, and they were not purely mechanical. They helped to work on the development?

Mr. HAMILTON. They were engineers; yes, sir; they were engineers.

Mr. BURNS. What sort of personnel did Winton have at that time who were, what you might call, development or research people, in that phase of it, rather than purely production?

Mr. HAMILTON. Well, they were limited in the research side.

Now, they had people, however, 2 engineers in particular at that time who were probably tops or right at the top level of diesel-engine designers in America, 2 of them; and they were right in the act.

One of them was assigned the forward development; one of them was taken out of ordinary production engineering and assigned to one phase of this development. That I have told you about this morning and that was the injection system.

We recognized we had to develop a new injection system, so we took one of the engineers and started him off on that program, and he was on Winton's payroll.

I agreed to take him on mine if Winton did not want to do it, but they were perfectly willing, and set him aside and gave him some space to work and some help and draftsmen, and he was working on the beginnings of the injection system which we now use.

Mr. BURNS. Was there any specific agreement that you and the Winton Co. would be permitted to continue this attempt to develop a type of diesel electric transmission for locomotives that you have been discussing?

Mr. HAMILTON. Well, there was no written agreement, but it was understood that is what the purpose of the whole thing was about; we certainly were not in any profit position as an enterprise, either one of us, at that time, to interest General Motors or anybody else.

It was only the potential there that interested General Motors, I am sure. I cannot speak for them, but so far as we were concerned, the whole conversation and the whole philosophy was tied up to that one point. It gave us an opportunity to go ahead.

I was satisfied with Mr. Kettering's interest in the matter at that time, because I did not know General Motors' organization then, how they operated, and who the people were, anything about them, except Mr. Kettering. But with his interest in the matter, why, I was convinced that he would carry the flag, and he did.

Senator O'MAHONEY. Well, as I get your story, Mr. Hamilton, it can be boiled down to this: That you and your associates, with the know-how, having conceived the idea of how the defects of the Electro-Motive transmission could be overcome with the diesel, having the staff which participated in this know-how, and under your leadership with the idea itself, you were lacking the manufacturing facilities and the capital to undertake the development of the potentialities you saw and, therefore, you turned to General Motors, after the head of Winton, which had already been taken over, suggested that that was the way to do it?

Mr. HAMILTON. Well, that is not exactly the situation, Senator, I do not believe. I think I ought to clarify that a little bit, with your permission.

Senator O'MAHONEY. Please do. All we want are the facts.

Mr. HAMILTON. If the problem had only been manufacturing something, just building it, making it, there would have been no problem.

We could have gotten money from our own bankers to do that. We could have financed our own plant if we needed it to do that. That was not the problem.

The problem was that the product that we knew how to make was inadequate, and to make a product which, in this case, was the engine, that would be adequate, was not considered in the cards at that time in the industry and, therefore, somebody had to supply the know-how and the energy and the capital to learn how to make the engine.

Once we learned how to design it, then problems took care of themselves. That was just ordinary manufacturing problems that could be met many ways.

So the barrier was really the fact that we had come to the end of the road. We no longer had an engine or a prime mover that would keep us in business, but we knew what would keep us in business, but we did not know how to design it.

Senator O'MAHONEY. That is what I meant when I spoke of the potentialities.

Mr. HAMILTON. Yes.

I do not mean we did not know how to make it. I want to put it this way: There is a difference between designing and making it. Making it, you put it in the plant and put some tools to work.

Senator O'MAHONEY. No. You had come to the end of the road so far as the old product was concerned.

Mr. HAMILTON. That is right.

Senator O'MAHONEY. But you saw potentialities.

Mr. HAMILTON. That is right.

Senator O'MAHONEY. And you were convinced that it could be successfully developed?

Mr. HAMILTON. That is right.

Senator O'MAHONEY. But you had no market for it; right?

Mr. HAMILTON. That is right. We had no market.

Senator O'MAHONEY. Because you had not built it yet.

Mr. HAMILTON. We had no market, but the market, of course, was there. We were satisfied it was there if we could offer the right product.

Senator O'MAHONEY. Yes; if you could build the product.

Mr. HAMILTON. That is right.

Senator O'MAHONEY. So your task was to find the organization that would produce the capital and the facilities to provide the necessary research and construction to build the new product?

Mr. HAMILTON. That is right; that is about what it adds up to.

Senator O'MAHONEY. And that you found in General Motors?

Mr. HAMILTON. Yes, sir.

Mr. BURNS. At that time there was a diesel switch engine in use, but, in your opinion, and as a result of discussions with locomotive people, it was not the type of engine which you felt would really be a success?

Mr. HAMILTON. Well, it was a success in a particular application that it had been employed in, but they were just a drop in the bucket. They were not taking the place of the great fleet of steam switching locomotives that the railroads used, and they were not being purchased as a matter of economic justification; they were being purchased because of some special operating condition that they fit better than the steam or where steam could not be used, like the electrified area on the Illinois Central around Chicago on the lake front.

That electrification had just been completed. They did not want to electrify all the little house tracks and tracks running under the freight sheds and so forth in that area, and so to put electric locomotives in there—and the law would not let them put steam engines—so these engines were used, and they did a very good job of it for that purpose.

Senator O'MAHONEY. Now, another question, if I may interrupt Mr. Burns:

At the time that this transfer was made, you sold your stock, that is, the whole 13,000 shares, for approximately $95 a share to General Motors, receiving the consideration in General Motors stock. Were you, therefore, investing the capital stock of your enterprise in General Motors stock on the promise that General Motors, through Mr. Kettering's leadership, would undertake the development of the potential which you saw and which you revealed to him?

You were not actually investing the capital of Electro-Motive in the new enterprise. It might have been possible, might it not, if you had found the ear of some other person with sufficient appreciation of the potential growth of the particular industry, in a bank or elsewhere, to get the capital, the capital that would be necessary to develop the new engine with the know-how that you and your staff of engineers possessed? Would that have been possible?

Mr. HAMILTON. Well, that, of course, is hypothetical.

Senator O'MAHONEY. Purely, but more or less realistic.

Mr. HAMILTON. I do not know. I could not sit here and say there was not anybody in America who would not have supplied the money if we could have found them, and then there—I cannot say.

Senator O'MAHONEY. But you found General Motors with the money and with the leadership?

Mr. HAMILTON. Well, we had more than that in General Motors. What I wanted to say was that of the companies that I knew at that time, many of them with plenty of financial resources, none of them had the mental approach to this problem that was necessary to take it at that stage that it was in then, and the courage that went along with it to move it to its point of success. At least that was our opinion in the matter.

Now, there may have been such people if you could have found them, and so on.

Senator O'MAHONEY. I am frank to say to you that so far as I am concerned myself, I know of few men with whom I have come in contact in my almost 20 years in the Senate—and I have come in contact with a lot—who stood out more than Mr. Kettering did as a man of vivid vision and comprehension and courage to carry out his ideas.

Mr. HAMILTON. That is what I say. There are those kind of people, but just who they were and where they were, they were not available to us as far as I know.

Now, I said earlier this morning Mr. Codrington and I thrashed this problem over back and forth between us probably for a year, how do we get out of this box we are in, and every possible phase of it was analyzed, and we analyzed the mentality, if you will, of the people that we know in the industry, those not only in the diesel industry and otherwise, but we did not know any of them that we felt had the courage to take hold of that thing in its nebulous stage, and start from scratch in view of the fact that we were going clear out of the metallurgy we knew at that time. We had to have crankshaft bearing loadings that nobody had ever used before, and that meant we had to go back and develop the bearing material to make the thing work, and that gets us into new metallurgy. We had to use piston temperatures that nobody had ever used. We had to devise a machine to measure the temperature of a piston clear across the crown. Nobody had ever done it before. That was the nature of the problem, so you had to have courage to step into that one.

Senator O'MAHONEY. Yes, indeed.

Mr. HAMILTON. Yes, sir.

Senator O'MAHONEY. And that is a great human quality.

Mr. HAMILTON. That is right.

Senator O'MAHONEY. And, as you say, it is not confined to narrow circles.

Mr. HAMILTON. Absolutely not.

Senator O'MAHONEY. It may be found anywhere.

Mr. HAMILTON. That is right.

Senator O'MAHONEY. The fact that it is found in America, all over the Union, is the thing that has made America great.

Mr. HAMILTON. You are exactly right, Senator.

Mr. BURNS. Mr. Hamilton, I would like to have you briefly describe the development of the first diesel which was put on the road in 1934, I believe, probably on the Burlington Zephyr.

Since we are going to try to reach another witness who is scheduled to be heard this afternoon, I would like you to sketch the development, and if you feel that there are more details which really should be made part of the record, you could supply them at a later time,

and we would be glad to include them right at this point in your testimony.

I understand that, as the result of these efforts which were put forth by yourself, the Winton Co., and the staff of General Motors, you did put on the road in 1934 the first true diesel train as part of the Burlington Zephyr? If you will tell us about the development of that at this point, please, sir.

Mr. HAMILTON. Well, I will try to shorten it up by giving the highlights of what happened.

The first decision that was made in connection with the development of this new engine, carrying on right where we left off a moment ago, was a decision made primarily on the approach to the problem by Mr. Kettering.

He had come to a conclusion independently and by himself in his previous studies and activities and the researches that they had done, that if you wanted to get the optimum horsepower out of a pound of metal in a diesel engine, you had to go to the two-cycle principle to do that, and at the same time retain exhaust temperatures, bearing pressures that were commercially practical.

So on that assumption, I will say this, just digressing for a second, that when he introduced that idea, Codrington almost had apoplexy, and I did not know enough about the thing to have my blood pressure go too high.

Senator O'MAHONEY. I can scarcely imagine that. I think you know a good deal about everything that comes under your attention, sir.

Mr. HAMILTON. I knew the history of 2-cycle efforts throughout the country, and there may be people in the audience who remember the old Elmore, who helped to build a 2-cycle gasoline-engine automobile in 1910, which used to blow up, and that was the reason why I thought that might have been within the memory of some of us here.

So there had been plenty of effort to build a two-cycle engine, but they had a bad odor connected with them, a very bad odor.

It could be done if you had enough apparatus and a stationary base, or a ship where you had a lot of auxiliary room, and room to put a lot of gadgets, but it was something else in a locomotive engine.

However, Mr. Kettering convinced us he knew what he was talking about, or at least that was the kind of line of exploration to be taken and undertaken. That is why I say we picked that up—that is where we picked up. It was a long, laborious process.

Now, I will move along fast. We, as I said a moment ago, had a lot of new things to learn, a lot of new things to do, that had not been done before; and, of course, those projects were pulled out, segregated, and a crew put on each one of the problems, knowing what they were coming to, including the development of an injector.

We were starting almost from scratch on that one. So we put all of these different projects into the hands of different people, and they were given the necessary staff and facilities and testing apparatus and instrumentation equipment to pursue their objectives.

Without covering the failures that we had, which were many, as I recall it, just as an illustration of the failures—Mr. Gene Kettering, the son of Dr. Kettering, who was a graduate of one of our engineering schools and also of our General Motors school, was assigned to follow the piston end of this development.

He made and tested 48 different pistons, 48 different designs of pistons, before we got one that would live long enough that made us believe we had a piston, something we could call a piston—48 of them that were tested before we finally got that one licked, and we went around and around through the whole engine the same way.

Now then, finally we were in shape and we decided to build 2 prototypes of this engine, based on this cylinder development, and it was all done with 1 cylinder; that is, an engine, after you do that, you can put as many of them on the crankshaft, 4, 6, 8, or a dozen or as many as you like, so you work with only 1 cylinder.

When we got 1 cylinder so it functioned, we decided to build two 8-cylinder engines, and they were of the size and general character that represented, in our judgment, at that time the type of an engine in physical get-up that would produce a good 100-ton, 600 horsepower switching locomotive.

That was a big market because I had made up my mind that an engine with the right characteristics would make a good commercial engine that the railroads would buy.

So we built two of those engines, prototypes, and built them by hand, and once they were finished, we exhibited them at Chicago at the World's Fair of 1933. They were sitting in a glass room at one end of the building of the Chevrolet assembly exhibit, and they furnished most of the current for the operation of that exhibit at that time.

During that year we found a lot of things wrong with them. We had living quarters right underneath in the basement below, with a mechanical crew around there, and by the heroic efforts of those fellows we kept those engines running that year so that we were not out of the woods yet.

The public did not know that; neither did the newspaper fellows, but there they were just the same.

By the end of the year, we knew what we had to do with that engine, so we proceeded to start plans to change and make corrections on the weaknesses and so forth and, of course, naturally, we scrapped those two engines as soon as the show was over.

But we proceeded then on the manufacture of engines for our locomotive trade.

Now, right at that stage, right in there, another development came on, one of a historical character.

In the fall of 1932, the Union Pacific Railroad, Mr. Carl Gray, whom you probably know very well, and Mr. Averell Harriman who, at that time, had been just made chairman of the board, and likewise one or two other people, Mr. E. E. Adams, whom you probably knew also——

Senator O'MAHONEY. I did.

Mr. HAMILTON. What was that?

Senator O'MAHONEY. I did.

Mr. HAMILTON (continuing). Decided among themselves that they were going to make a new motor train—they had plenty of gas-electric motorcars on the railroad. As I told you this morning, they had been pioneers of the McKeen car, and as time went on they had bought a lot of gas-electrics from us, so they had a lot of experience.

They determined they were going to make a high-speed train, a small train, to operate on the railroad as a competitor for the buses and

even the airplanes as they thought airplanes were starting at that time.

This train was to be small, comfortable, and have a speed up to 120 miles an hour.

They came to us with their plans. We had long sessions back and forth as to how that trick could be done, and the Pullman Co. was in the picture, the three of us, the railroad, the Pullman Co., and ourselves, we finally cooked up a design.

After the design was set they made a wooden model of the design, and Mr. Stout, the airplane designer, the man who had designed the original Ford three-motor plane, took the model over to the University of Michigan, ran the wind tunnel tests on this model because we had to see what wind resistance we were going to meet with and how much horsepower it would require and how fast we could run this thing.

We got all this done, and when we were finished, the railroad announced they were going to build the train.

From the model, the newspaper fellows got pictures of it, and all of you remember it, but that launched an entirely new activity.

Immediately following that, Mr. Budd, president of the Burlington Railroad, said, "I am going to do the same thing."

Senator O'MAHONEY. Well, perhaps it might be appropriate for me to say at this point that it was one of those engines drawing the city of Los Angeles that brought me from Cheyenne to Washington to conduct this hearing.

Mr. HAMILTON. Thank you. I am glad it got here on time.

Well, the next point, to answer your point, and I am getting right to that—when the Burlington, Mr. Ralph Budd—decided they were going to build a train, they took a little different tack, but the same thing—he decided, knowing about our development with the diesel, he talked with Mr. Kettering, he talked with me, they knew all about it.

Now, what we were doing, they knew all about these engines at the Chevrolet exhibit, and he knew about them falling apart, incidentally, and all of that, he decided, however, he would like to take one of those engines for his train, have one of those engines for his train.

So we were to build him one, and that was done, so we put the two trains in operation the next year; one of them with a gasoline engine in it, 600 horsepower—that was the Union Pacific, that was the first streamliner; then came the Burlington Zephyr, a three-car train, again the same general character and general get-up, with the diesel engine in it.

Now, that is the first diesel we built and put on the railroad, and that was sold and considered a commercial product. That went into the Zephyr, the first Burlington Zephyr, went into it, when it went into service on the railroad.

They did not put it in service right away. They used it for exhibition purposes and tested it, and so forth, but that was the first one.

Does that answer your question, Mr. Burns?

Mr. BURNS. And that diesel was actually ordered in advance by the Burlington Railroad?

Mr. HAMILTON. Yes, sir.

Mr. BURNS. Now, what was the next step in the manufacture of diesels of any type, diesel locomotives of any type, after you got this first one on the road?

Mr. HAMILTON. Well, immediately following that, after the Zephyr went out and went to work, well, really before that, before there was any great really historical background for that, the Union Pacific started to expand their philosophy.

In fact, before we had got the first train in operation, the Union Pacific had decided to build a five-car train—that was the first City of Portland, Senator—and used the diesel by that time, they being satisfied that the diesel was the answer.

At the time they built their first train the railroad—Mr. Adams, particularly, built it experimentally; he did not want to go out and fail and expose the railroad to ridicule by failure—but at the time they got ready to step ahead, which was later in 1934, they started ordering powerplants and trains, and they moved so fast there that it was pretty hard to even tell the story.

In no time at all they projected first a 5-car train, then the 9-car train, then the 12-car train, and they moved the horsepower right quick from 600 to 2,400 horsepower, so we found ourselves building 12-cylinder engines, 16-cylinder engines, and multiplying them to provide the horsepower for the first fleet of the Union Pacific diesel trains; and that group eventually evolved the first City of San Francisco, City of Portland, City of Los Angeles, and the first two City of Denver trains came out of it.

All of them, all the equipment from the car builders and the power plant from us, were ordered right one after the other.

Senator O'MAHONEY. The City of Denver was the first of the whole fleet, was it not?

Mr. HAMILTON. No; the City of Portland was by accident. That was a five-car train, and then came the City of Los Angeles.

Senator O'MAHONEY. I rode the City of Denver before I rode the City of Portland, so it came first in my mind.

Mr. HAMILTON. But they all came so fast together, Senator, unless you were there watching, you would not know which one was the first, because they all—the reason I say that it was a headache for our people, too, was because we had to get people who could work 20 hours a day and sleep 4 in order to keep them running at that stage of the game.

We had so many of them, and they were scattered from Chicago to Los Angeles to Portland and San Francisco, and we just did not have time to digest the problems that went into it, you see, but we finally made them go.

Now then, right after that Mr. Burns, right following that development, came this development: We recognized at that time while all these first locomotives that were built were part of the nature of the train, they were the lead car, if you will, which was the powerplant, that is, that was the locomotive, in some cases they were tied permanently to the train through an articulation arrangement, but they belonged to that train; they were designed to pull that train.

In some cases we had auxiliary generating equipment in the locomotive to supply all of the train lights, and in some cases even heating equipment. So they were tied to the train; they were not locomotives that you could cut loose and pull any train on the railroad. They had to stay there.

We knew and, of course, the railroads were, of course, in touch with us all the time. They knew what we were doing and what we were thinking.

They insisted they wanted diesel locomotives to do any kind of a job on the railroad, that is, haul any kind of a train, and we knew that was the natural course of evolution.

So we designed for experimental purposes, for our own purpose only, an 1,800-horsepower cab or locomotive, and got permission from General Motors to build one of them. That would give us two running together in multiple which would be 3,600 horsepower, and we did not have a plant at that time, any facilities of building the cab superstructure and all that kind of stuff. So we made a deal with the General Electric Co., and so they started building them at the Erie works of General Electric in 1934, late in 1934.

Mr. BURNS. These locomotives that had been built for the Union Pacific and the Burlington, how much of those were built by General Motors and how much were built by other companies?

Mr. HAMILTON. Well, all of the superstructure and all of the trucks were built by other companies to the design that the builder, in this case Pullman and other car builders and ourselves, worked out jointly together, so that the apparatus would fit and all that; and then we assembled the mechanical and power equipment in those cars.

The cars themselves—that is, the superstructure and the undergear—were all built by car builders. We had no manufacturing facilities at that time.

Mr. BURNS. Were the engines made by the Winton Co.?

Mr. HAMILTON. That is right.

Mr. BURNS. And where did you get the electrical equipment?

Mr. HAMILTON. The first trains were all from General Electric Co.

Now then, before we—there is a point I want to bring in right here—after we announced we were going to build this first pair of units purely for experimental purposes—and they are like a laboratory, you put things in them you would not normally put in locomotives that you were going to have to use in everyday service—two other railroads wanted to get into the act.

One was the Santa Fe and the other was the Baltimore & Ohio. We could not talk them out of this. They wanted some of their own to play with, and we offered them these for tests and demonstration and so forth.

They said, "No, we want our own. You fellows are going to run this thing all over America, and everybody will want to try it. We want one of our own."

So we built an extra one for the Baltimore & Ohio, and two for the Santa Fe; that made five that we built at Erie at that time, all at the same time.

Mr. BURNS. Were those considered for passenger service?

Mr. HAMILTON. Those were considered for everything. We tried to work out a combination there that we could test whether they were any good in freight service, any good in passenger service. We thought we ought to learn what that sort of animal could do on a railroad alongside a steam locomotive.

So we built this locomotive along that line with double-end apparatus. Each cab had a control apparatus at each end. You do not have

to turn them around; they were multiple. The two cabs together were 3,600 horsepower.

All those locomotives came out about the same time. Santa Fe got theirs and, incidentally, they changed their plans before they got it, and it was the locomotive which they used to launch the first Super Chief, which was one of the early transcontinental trains.

It was the locomotive that handled the first schedule of 39 hours and 45 minutes on the Santa Fe Super Chief between Chicago and Los Angeles.

The B. & O. used theirs between Washington and New York in pulling one of their fast local trains.

We took 1 of the other 2, and they were tested on virtually every railroad in America, doing every kind of a job they could do for quite a long time.

They worked on all the lines. Those were the locomotives that established in the minds of the Baltimore & Ohio that they could really go ahead, and they started buying power, and did buy power as soon as we were able to build it for the Capitol Limited, and they have been on there ever since. That was immediately following that.

Now, that is what happened immediately after the launching of the first Zephyr.

A little time in there, and by 1934—I think I might go on with that point—by 1934 we had decided that we had to have a manufacturing plant of our own. It was not practical to continue to operate the way we were. The think was blooming too fast, moving too fast, so we built, started, the first unit of a plant at La Grange, Ill., in the spring of 1935, and that was built there. The first engine that we turned out of that plant was a switch engine in May of 1936.

Then operations began to expand fast from that point on. The locomotive, passenger locomotive, developed into a finished product quickly of the streamlined character with the cab up, and with all the fancy colors that you are accustomed to seeing today. They all expanded very fast from the early design.

So by 1938 we had gone so far and so fast, and the acceptance of the locomotive had been so great that we decided to do another thing at La Grange, and that was to tool up to manufacture our engine in a volume basis, and the electric equipment, as well, the transmission, so we added that to the plant in 1938.

Now, going backward there for just a minute, one of the first things that we did was to start a switch engine program—and I covered that quite a little this morning, and I want to get that in the record because it is an economic story involved in it—as soon as we got some engines to spare, we built a couple of prototype locomotices with this new engine in it, and put two of them on an eastern railroad. They were built at General Electric's Erie plant.

Mr. BURNS. Was that 1934 or 1935?

Mr. HAMILTON. They were built in the early part of 1934. I think they went in service in the spring of 1935. That locomotive was to have the characteristics we had concluded in our own minds for good switching locomotives, to solve the problem, because here we were now, looking over the record in 1936, we brought out our first locomotive, and I checked it that time to see what had happened in that field, and I found that the whole industry from 1924 on through 1936 had built

190 of these diesel switching locomotives, that is all; whereas we, in the motor-car field had put out some 800 or 900 of those things, and yet the economics involved, the economic potential in this switching service, was far greater than it was in the motor-car field.

Mr. BURNS. What years were these?

Mr. HAMILTON. 1924 to 1936.

Now, therefore, the first thing we did, after we had these prototypes working, we knew the engine was right, then we set up to manufacture these locomotives, and the first movement in that direction was this: we scheduled 50 locomotives, we built 50 of them. None of them had been sold, we just put 50 of them into production. We did that to get a cost figure; there was no other way to find out what a locomotive like that was going to cost except to build it.

We had estimated it, yes. Now, then, I would like to introduce this one there because I am going to blow my horn a little bit here, senator.

Senator O'MAHONEY. You are welcome to it, sir. I have tried to help you a little bit this morning already.

Mr. HAMILTON. Thank you.

At that time, and now we get into an economic side of this picture, at that time, and that was an interesting thing because here we were now, we are in 1936, and Electro-Motive had been running in the red for 6 years. We had not been making any money for the corporation; we had been at the table all right but we had not done any more than been supplied with food, so to speak. We made no contribution dollarwise.

Senator O'MAHONEY. Oh, you got your salary, but not your savings.

Mr. HAMILTON. But we had to get that out of Chevrolet; they had to pay our salaries. We were not doing that.

Senator O'MAHONEY. Let us emphasize that. [Laughter.]

Mr. HAMILTON. Well, that suits the Chevrolet fellows all right.

Well, anyway, here we were in an economic situation. So, taking a look at the switch engine, the switch engine that had been built by the industry at that time, that weighed a hundred tons and had 600 horsepower, sold for $84,000—that was the market price, that is what they sold them for—when we made a study of what our costs ought to be, we did not know what they were going to be, but what they ought to be, we decided to market the locomotive at the outset—we could not justify it for any more than $72,000. So we introduced the locomotive in the market at $72,000.

Now, there was a hook on that one, however, that we had to try out on our railroad friends.

We said to them, "This $72,000 price is for a standard locomotive. There are no modifications. The only thing we can do for you is to give it the color you want. We will paint it any color you like, but nothing else. Take them right off just as they come."

Senator O'MAHONEY. No ribbons?

Mr. HAMILTON. No ribbons, right off the shelf—just as they come—$72,000.

"Now, if you will go along with us and accept a standardized locomotive without all of the peculiar gimmicks that you are accustomed to having on your particular locomotive, and that your competitive railroad over here would not have on a bet," which was the customary practice in the steam locomotives in those days, "then this is what

will happen: as our costs go down we will reduce the price of the locomotive; that is the bait. But you have got to give us a start and you have got to buy a standard locomotive."

So we made a deal with some railroads on that basis, and they had my word that as we reduced our costs we would not absorb that in extra profit nor carry it over to take the loss on some other models. On that model if the costs went down they would get the benefit of it.

Senator O'MAHONEY. On that model?

Mr. HAMILTON. We were talking about; that is the only model we were offering at that time.

Senator O'MAHONEY. Yes.

Mr. HAMILTON. We followed the same practice on all models as time went on. The price of that locomotive went down successively $72,000, $69,000, $67,000, $65,000, $63,000, and to $59,500, and that is where it was when the war came on.

We passed; we dropped the price in those steps that I have just indicated.

Senator O'MAHONEY. When did you first sell any of these locomotives?

Mr. HAMILTON. 1936.

Senator O'MAHONEY. You built 50 in what year?

Mr. HAMILTON. That year. We put them in production. I think we finished that year about 27 or 30. But the balance was finished next year. We put them in production and started manufacturing that year, and I think we finished up—we had to build the plant that year, and we did that and also built about 30 locomotives.

Senator O'MAHONEY. My understanding was from what you said in order to determine what the costs would be as compared with your estimates——

Mr. HAMILTON. Right.

Senator O'MAHONEY (continuing). You thought it was necessary to put them into production?

Mr. HAMILTON. That is right.

Senator O'MAHONEY. So you decided to produce 50 locomotives?

Mr. HAMILTON. That is right.

Senator O'MAHONEY. When you came to that decision, did you have any orders?

Mr. HAMILTON. No, sir.

Senator O'MAHONEY. So you undertook this rather large expenditure necessary to produce 50 locomotives without a sale having been made at that time, or an order?

Mr. HAMILTON. That is right.

Senator O'MAHONEY. When did you make the first sale?

Mr. HAMILTON. Well, I cannot tell you when we made the first sale, Senator. I know when we finished the first locomotive that was sold, and that was in May 1936.

Senator O'MAHONEY. When did you begin to test it?

Mr. HAMILTON. Just as soon as they came out of the plant. We had prototypes already that we had built before this. So that we knew when they came out, other than putting them on the test track and to see that the manufacturing and assembling was correct, that was all we had to do.

Senator O'MAHONEY. Yes. But the prototypes you did not test on any railroad?

Mr. HAMILTON. Oh, yes. They were on the Lackawanna here, and we had that background to design this locomotive from. We built them at the Erie works 2 years before that.

Senator O'MAHONEY. That is, with your prototypes, and they were not the Lackawanna property?

Mr. HAMILTON. They paid for them.

Senator O'MAHONEY. They bought them after the tests?

Mr. HAMILTON. They saw what they could do, and they bought them.

Senator O'MAHONEY. But the tests were made before the purchase?

Mr. HAMILTON. Yes.

Senator O'MAHONEY. Did you have any similar tests before purchase on other railroads?

Mr. HAMILTON. You mean of that particular locomotive?

Senator O'MAHONEY. Of any.

Mr. HAMILTON. Well, I do not think so. I cannot recall, because by that time the locomotive was already commencing to establish itself so fast that the railroads started giving us orders without strings.

Of course, we had absolute guaranties on these locomotives. The railroad was not taking any risk. We guaranteed a certain operating cost; we guaranteed a certain performance, and we gave them an absolute guaranty on the locomotives so far as their design, material, and workmanship were concerned, covering then everything except abuse and wrecks. So they were not taking any chances.

Mr. BURNS. How many locomotives were built and sold before you began to construct the plant at La Grange?

Mr. HAMILTON. Well, I do not know just—when you say locomotives, now, are you talking of what I think of as a locomotive, a locomotive that handles those fast trains across the continent, and while they were part of the train? While they were part of the train, they were, in fact, locomotives. In fact, they were tied to the train and could not be untied; it did not make any difference, they were a locomotive.

Mr BURNS. How many diesels had you developed and made, starting in 1934 on these particular railroads?

Mr. HAMILTON. Around 20.

Mr. BURNS. And each of those was ordered by the railroad in advance and made according to their requirements?

Mr. HAMILTON. Well, yes; under the circumstances, yes, that is right.

Mr. BURNS. So that before you actually went into this mass production development, you had sold approximately 20 of these diesels that were on the road?

Mr. HAMILTON. They would have been 20 that we would have built in our own plant had we had a plant. We did not have a plant, but there were twenty-some-odd units that went out that we would have built ourselves had we had the facilities.

Mr. BURNS. Each of those was ordered in advance?

Mr. HAMILTON. That is right.

Mr. BURNS. Were those sold for cash? Did the railroads pay for them at the time they were purchased?

Mr. HAMILTON. Yes, sir.

Mr. BURNS. Now, with respect to the 2 prototypes of the switching engine, were those accepted by the Lackawanna before you began to produce the total of 50 which you have just discussed?

Mr. HAMILTON. Yes.

Mr. BURNS. Did you have any orders for any of the 50 before you actually began production of them.

Mr. HAMILTON. Not that I recall. I think during the period we were producing them we did get some orders, but I cannot swear to that just how that happened. They all moved fast. We increased our production right from that point on, never slowed down.

Senator O'MAHONEY. I think you said, in response to a question, that you decided to build these 50 without having received an order or having made any sales.

Mr. HAMILTON. That is right. Well, that was the decision made then, and the orders had nothing to do; but before the locomotives were finished I am sure there were some orders placed.

Mr. BURNS. Do you know how much money was used in the development of these locomotives from the time that General Motors took over Winton and Electro-Motive in 1930 until 1934 when you made a commercial sale?

Mr. HAMILTON. No; I do not. The reason I do not, the reason I give you rather a quick answer on that, is that I have attempted to get that figure myself without success, and while we can get a reasonably close, pretty reasonable, figure, yet the facts are there were so many people in the corporation working on it, doing certain parts of the job, and the costs were not segregated, it was a part of their budget, so it was awfully hard when the job was all over to find out just exactly how much money had actually been spent that should have been charged to the job.

But now if you are talking just about the engine itself—is that what you have in mind, or the whole program?

Mr. BURNS. Well, the whole program up to that point.

Mr. HAMILTON. The whole program, I would say in the order of $4 million.

Mr. BURNS. Were these engines for these locomotives that were built in 1934 and 1935 built at the Winton plant?

Mr. HAMILTON. Yes, all engines were built at the Winton plant until 1938, all that we used.

Mr. BURNS. In 1936 when this plant at La Grange was beginning to produce locomotives, were the engines still produced at Winton?

Mr. HAMILTON. Yes, sir.

Mr. BURNS. What was produced at La Grange?

Mr. HAMILTON. Just the superstructure and the trucks and assembly; that is all. The electric equipment was supplied by the electrical people, the electrical firms. The engine was supplied by Winton, made in Cleveland; the superstructure and trucks were built by us at the La Grange plant, and the assembling of everything was made there.

Mr. BURNS. When the La Grange plant was designed, was it designed in such a way that it could expand into the manufacture of the engines and the electrical transmission?

Mr. HAMILTON. Yes, sir; in three directions.

We designed and laid out the plant—we did not know what the problem was then. We knew that to make this a commercial proposition we had to learn how to produce these locomotives following, to some extent, modern concepts of volume production.

But, on the other hand, we were dealing with such big pieces and heavy pieces, big components that the then conventional method of moving material, that is, the conveyor system and all the other gear that is used for transportation of material in these high production plants, were not applicable.

The pieces were too big. So we did not know what the problem was. We had an idea how we were going about it, but we had to learn it first, so we built at the outset a big bay with the ultimate, the optimum, in flexibility. It had a hundred feet span, was 500 feet long, and had a 200-ton crane in it; that ran the full length, so we could build the locomotives in any direction or shape we wanted by picking them up and moving them around, you see.

But not knowing what else to do, we had to go out on a limb, and then we constructed the plant so that we could build in three directions, and we learned how to build on a volume basis, and we learned slowly and by degrees.

We did not know the answers to that one at the outset, so all we could do was to lay down a broad pattern that had enough flexibility to meet the problem whichever way the cat jumped, and that is what happened.

Mr. BURNS. Were these first 50 built on an assembly-line plan?

Mr. HAMILTON. Yes. They were, after a fashion. But the switch engine is a pretty simple animal so far as the superstructure and the cab, and that is all we built there; and that is just very simple, a very simple thing.

We did jig for them obviously because we never put anything in service that had not been built on jigs; we did jig and set up the necessary jigging for that. It is not tooling per se, as we call it; it is tooling, but it is the crude end of it, jigging.

Mr. BURNS. At what point did the LaGrange plant make the complete locomotive, including the engine and electrical transmission?

Mr. HAMILTON. In 1938. There is a point in there that I want to bring in, too, I might say, and that is that we were faced with right along through that whole period of constant expansion of the plant. Our switch-engine demand went up fast, so we were constantly expanding to meet that problem. Road power went up fast, passenger locomotive business went up fast, so that before we could complete one plan, why, we were faced with an additional, so we were always overlapping.

We were starting a new program about the time we ended an old program.

The economy of these locomotives, once they got in the field, were way out and beyond anything that we had anticipated, even the passenger locomotive, but primarily the freight and the switching locomotive, and I use the switching locomotive to make the point.

At the end of the first month, you could almost go out and count up what you have saved on switching locomotives because of the method of accounting and the simplicity of that accounting.

When you get into a passenger locomotive on the main line, that is something else again. You have got to run a few hundred thousand miles and see where you are at before you can really come up with

an intelligent accounting or an accounting as to what the locomotive has done and compare it with steam.

So the first reaction was on these switch engines, and what the railroads did and what we did, we proposed at that time, in order to get the cream on the thing and get the best economic showing, that they be assigned to what we called 24-hour tricks, that is, operation where there is a switch engine working in a certain area or territory around the clock, 24 hours a day, generally 3 crews, each one of them working 8 hours.

The steam engines, they always had to go to the roundhouse to change crews because you needed to have the fire cleaned, you had to have water, and you had to have a few services on the steam engine; so the locomotive was always in the process of going to the roundhouse, getting a crew change, and a new crew coming back, so that would take a portion of the time just going back and forth.

With the diesel we fixed it up so that it would stay out there day and night and work for 1 week steadily from Monday morning to Sunday night without ever shutting down, without going for fuel, without any service requirements except a crew change at the end of the shift period.

When we found that kind of assignment, that is where we started these switchers, and we soon found out right away on those kinds of assignments that those switchers earned at the rate of 25, 30, 35 percent of their price per year in economy, and the minute that happened, the effect of it on these railroads was just like, well, you can imagine what it was, at that time, particularly in the late thirties, where they just had been coming out of the depression, most of them in financially tight conditions by virtue of what had happened to them.

Along comes this product that would pay for itself in earnings so quickly; there the answer was an immediate acceptance.

From the time we started to just take orders they were giving us for diesel switchers, why, as an illustration of that point, I checked here a while back and between the first locomotive that we put out, which was in May 1936, out of the plant, and the date that the Office of Defense Transportation took us out of the switch-engine business, which was at the end of 1941, we had put out 642 of those locomotives.

So in that short period of time, there were 642 of those locomotives that went into service against the whole industry's contribution in the 11 years before that of only 190.

So that proved that all we needed was an engine that would do the job, a switch engine that would do the job, and the minute we proved it, the minute we introduced it, the railroads bought them faster than we could make them.

Mr. BURNS. So that after you showed those two prototype switch engines there was no problem in selling the engines?

Mr. HAMILTON. None at all.

Mr. BURNS. What were the factors which caused you to decide to build the entire locomotive and cab instead of simply the engines, which was the business you were originally in?

Mr. HAMILTON. You mean the cabs and trucks?

Mr. BURNS. Yes. You started to build the whole thing at La Grange.

Mr. HAMILTON. Well, there were two bites of that. One was, we first started to build the cabs and trucks, and then after that we started

to build the other components there, but you are talking now about the cab and truck itself?

Mr. BURNS. Yes, because your experience over the many years had been trying to develop the combination of the engine, and you made that through Winton, a combination that would go on the rails, and you bought the cab and trucks, and so forth, transmission, from other people, and the first successful diesel passenger locomotive in 1934, and the first few after that were the cabs and trucks, and so forth, were also made by other people. So what were the factors that caused you to want to make the entire locomotive in your own company?

Mr. HAMILTON. I get your point. It was an accumulation of problems there.

In the first place, aside from what our program was, and that we wanted to work to, we had the practical problem where these things were built in outside shops, and here is what happened. We had to accept all this involved and delicate apparatus through their shop and have it come in through their storage department to be handled through their shop. Some of it would get lost in the process, and finally after you would sit around with this on the floor awhile, why, we would get a crew together and start putting it together.

We had to use the builder's shop labor for the installation, and whether he was a good mechanic or a poor mechanic, that was just too bad so far as we were concerned.

When the work was not right, we had to tear it out and do it over again; we could not say that a man is no good, and get another one in his place.

So we were faced with the shop problem from that standpoint.

There was no responsibility on anybody's part, on that part of the work because the builder said, "You fellows installed it."

We did. But we installed it with their labor over which we had no control.

So there was no end of headaches.

So after we got them on the railroad, we had to get socks and lunch baskets out of the fuel tanks, and socks out of the pipes they had left in there, and dirt, and so forth, and it took us the first 30 days to get them cleaned up, so they would run after those kind of experiences. So we decided that was not too good.

Now the other side of it was this. We fully intended at that stage to set up standard models that I spoke of to the Senator a moment ago like the standard switch engine on which we changed nothing but the color, so the whole philosophy was based on that.

To do that we had to have a substantial tooling and jigging arrangement in the manufacture of these car bodies and trucks because they represented labor and material in a big way the same as the rest of the locomotives did, so in order to do that we had to do it ourselves.

There wasn't any outside builder going to do a thing like that unless we came along and guaranteed for a long period of time a big volume of production for him. We wouldn't do it, so if that was to be done, we had to do it.

So those are the two major reasons. There are others, but those are the two major reasons.

Mr. BURNS. Do you know what the approximate capital investment was in this plant at La Grange after it was equipped to make the complete locomotive?

Mr. HAMILTON. Well, now, you have jumped something there. When you say "complete locomotive" do you mean at the time we were just building the cab and the trucks and sending the engine over from Winton and buying electric equipment from General Electric or when we were building—later on you see we built the electric equipment there and the engine there, which we didn't do at the outset, when we built only the cabs and trucks and assembled them. What point do you have in mind?

Mr. BURNS. I thought it was in 1938 when you were building the engines.

Mr. HAMILTON. That is something else again. At that same time we decided for the same reason—even in our own family we got to a point where we weren't getting along with Winton. We couldn't get the results out of Winton we wanted for a combination of reasons.

Furthermore, the engine itself as originally designed had the influence of the Navy in it tremendously. That I didn't bring in here, but it is in the record and so forth.

The Navy was interested in the same engine with certain modifications for the submarine fleet, so in the design of the engine, particularly the multiple cylinders, the 900 horsepower or the 1,200 and 1,600, we had done a lot of things to it engineeringwise to suit the Navy to meet submarine requirements that complicated the engine for use in a railroad, particularly from a manufacturing and a railroad—particularly from a manufacturing and a maintenance standpoint.

But the Navy still wanted it. So we left that engine as it was at Winston and set up and designed a new engine that used all of the experience we had accumulated on it and tooled up for the new engine at La Grange in 1938 to manufacture an engine exclusively for the locomotive, and at the same time, we decided to build our own electric transmission in 1938 at La Grange, for a lot of very good reasons, but at any rate brought under our own control both in design, manufacture, scheduling, and responsibility.

And at that time, by the time we got to that stage, we were in the order of 22 million in the plant, building, tools, and what have you.

Mr. BURNS. And did you build any other shops in other parts of the country to service these locomotives once they were on the road?

Mr. HAMILTON. No.

Mr. BURNS. Do you have any branches or depots for the repair or servicing of the locomotives? I understand there were 5 or 6 in the warehouses or factory depots.

Mr. HAMILTON. Well, there is a little tail to that cat, too, if you will pardon my language.

Back in the middle twenties, right at the early days in the motorcar business, and I think I covered that once before, we decided that it was necessary to have available, close by, the necessary spart parts to support these motorcars in service, so we set up warehouses strategically located in different parts of the United States.

Now then, as time went on after those care were in service, the next thing that we were faced with was that the railroads were not qualified

to maintain ignition systems, carburetors, and other delicate apparatus of that kind. They could take care of the heavier work of maintenance. They had shop people that could do that, but they were not prepared to do it.

So we, just as a matter of defense, got to setting aside a little room in these places, and we would let the railroads send their carburetors and their ignition systems over there, and we would send them another supply, and we would bring the old ones in and overhaul them, repair them, and then we would send those out. So we took care of that sort of work for them in many cases. And that went on through the motorcar period, which ended in 1930.

Now, when we introduced the diesel locomotives, we had the same thing, only more components that required the attention of that character. So we started in the same places repairing injectors, governors, and other delicate pieces of apparatus, so they gradually, those warehouses, the parts warehouses, gradually expanded to more than just a warehouse. They became small repair stations for doing this special work.

Now also, as this whole program evolved over a period of time, the railroads leaned on us to repair their main generators, and their traction motors, which are big units. They are big things. They weigh on the order of from 6 to 11 thousand pounds apiece, and they are full of lots of involved mechanisms.

The railroads sent those back to us for repairs when they failed or when they had run their miles out and had to be overhauled. We found ourselves sending them from all over the United States back to La Grange.

So slowly in the points where the population of locomotives were heavy we started to further expand these warehouses. We had to repair electric traction motors, and eventually the generators, so that was a further enlargement of the same philosophy.

And as time went on the railroads finally got to a point, some of them, not all—where they wanted us to overhaul their engines for them, too, the complete engine.

So instead of sending those all the way across the continent or from New York to La Grange, and then sending them back again, paying the transportation on them, having them tied up in inventory or in freight trains, we decided to, in some places, first one, then another, to expand facilities for rebuilding the engine.

So the net result of that is that we had gotten now into pretty big operations in certain spots over the country just by a slow evolutionary process that started back there in 1925, and we are doing that. Does that answer your question?

Mr. BURNS. Yes. Now, was that a change in the general practice of the railroads with respect to repairing and servicing steam locomotives?

Mr. HAMILTON. Oh, I think so. The railroads are perfectly capable and have been, they have been in the steam-locomotive business for a century, so they had developed all the technique, all the people, all the facilities that they needed to take care of steam locomotives and everything about a steam locomotive was known to them.

Now, I do think there were places in the country where Westinghouse, with their intricate equipment, some of the feedwater people that made a very involved gadget probably had facilities to support

the railroads and help them on certain complicated things, but in principle they overhauled their own.

When the diesel came along, here is the problem. You had one on this end of the railroad, one on that end, they were running everywhere, there was no concentration of them, and we had, in the locomotives, a lot of involved things that take a long time to acquire the technique, experience, and the little fixtures necessary to do a good job repairing and not only that, but there wasn't enough of it in many cases at the outset for them to develop a crew to do repair work. There was no efficiency.

By our having a place not too far away, and every railroad sending all their stuff in there, we could have enough business and enough work to keep a couple of good mechanics on the job all the time.

Senator O'MAHONEY. The point seems to be this, Mr. Hamilton: That when the steam locomotive was the primary source of power for the railroads, the railroads had shops all along their respective lines.

Mr. HAMILTON. Right.

Senator O'MAHONEY. In which their skilled mechanics were employed to repair the engines and even to rehabilitate them sometimes almost completely.

Now, the development of the diesel end of the warehouse and repair shop schedule of the General Motors, taken over from your original electric-motive company, would indicate a transfer of this shopwork from the railroad shops to the shops of General Motors divisions, does it not?

Mr. HAMILTON. No; I don't think so.

Senator O'MAHONEY. Well, you said you were expanding your repairs in the shops?

Mr. HAMILTON. When I say expanding, the expansion that has occurred already and it probably is a matter of record or the question wouldn't have been asked here by Mr. Burns, but the expansion is a drop in the bucket.

The small railroads have very few facilities and have just a few locomotives usually. The big railroads, most every one of them have set up giant facilities of their own to rebuild these locomotives. They have their own shops.

About the only time they use our facilities is to take care of their peak load. When they get volume they can't handle, they will send the overflow to us.

Senator O'MAHONEY. You mean the railroads are using their own shops to repair——

Mr. HAMILTON. Oh, they spent millions of dollars on beautiful new shops, the Union Pacific——

Senator O'MAHONEY. To handle the diesels?

Mr. HAMILTON. Yes, sir. The Union Pacific that you know so well has just completed a plant at Salt Lake City, Utah, as big as this building, and thoroughly tooled and equipped to maintain, overhaul, and repair diesel locomotives. Yet we have a plant right there too.

You say how come. Well, that is the point. The cycle problem of maintenance on the diesel can run into peaks like that, and they run the miles out on trucks and motors, run them out on generators, run them out on engines and they cannot always cycle their rebuild

program to have a uniform flow. They get caught on peak, so we are there as standby.

If they get caught and can't handle their peaks with their normal staff, why, then they will ask us to step in and take a few. But the percentage of that that we are taking is a drop in the bucket.

Senator O'MAHONEY. The chart which was displayed here yesterday indicated, as I recall, that the peak in the manufacture and sale of the diesel engines, both for freight and for passenger, was reached about 1950. I think the total at that time was somewhere——

Mr. HAMILTON. No; I think we had a higher peak than that. During the Korean buildup is really when we went to the top. We went way up in production, all builders did. Everybody was working at their capacity at that time, and that was in 1952 and 1953.

Senator O'MAHONEY. I was speaking only of the total.

Mr. HAMILTON. Yes, the totals. Around 1953 I think was where the peak was.

Senator O'MAHONEY. Now in 1950 apparently the peak was for switchers 4,174 from all sources, for road switchers 1,240, for road freight 1,585, for road passenger the peak was the following year, 188 instead of 158, whereas in 1954 these figures had dropped, in the case of switchers, to 983, road switchers 635, road freight engines to 85, and road passengers 27.

Now what does that indicate for the future?

Mr. HAMILTON. Before I answer your question, Senator, I would like to call your attention to this fact: that these statistics here—who prepared these? Where do they come from?

Clause 4 says this: "Diesel figures from 1934 to 1944 are shipment, figures from 1945 to 1954 are for orders."

(Discussion off the record.)

Senator O'MAHONEY. For the record, I might say that the testimony of Mr. Hamilton has been tremendously interesting to everybody in the room. I know that from the press, I know it from my staff and I know it from myself.

I think that the presentation of the material within the experience of Mr. Hamilton this afternoon has been a very excellent example of what can be done in a congressional hearing when frankness on both sides is employed.

I think that this session this afternoon would be great food for thought for the Brookings Institution, for the three professors who interviewed General Motors executives and for the other General Motors executives.

I think you have given an excellent example of what a business executive ought to do, Mr. Hamilton, in discussing with a congressional committee one of the most important problems that can come before our Government, and I hope that all of these gentlemen I have named before will take heart from the way you have been treated at this table to believe that they might be treated the same way.

Mr. HAMILTON. Thank you, sir.

Senator O'MAHONEY. Will you proceed?

Mr. BURNS. Will you tell us the approximate capital investment in the diesel facilities, both at LaGrange and at these other branches?

Mr. HAMILTON. Now, just a minute; my mind was floating a bit. Ask that one over again.

Senator O'MAHONEY. We will take a recess for 2 minutes.

Mr. HAMILTON. Well, I can come up faster than that. Repeat your question, please.

Mr. BURNS. While I was talking with you informally, you mentioned a figure of about 75 million for plant and equipment, and an inventory of about $60 million.

Mr. HAMILTON. Yes, I see what you are talking about, true enough.

Our total investment, according to my memory—and I am going by memory, but I think it is pretty accurate—our total investment in dollars that we finally attained, and that represents right up to around 1954, after we got through with the last project in tools and equipment, plant, land, and the manufacturing facilities, the peak reached was around 74 million.

Now, of course, by that time it involved 3 plants, 3 manufacturing plants, 1 in Cleveland, 2 in Chicago, in addition to these branches and everything that we own, that is the peak.

Mr. BURNS. Have you any division of that sum between the three manufacturing plants and these branches that you have?

Mr. HAMILTON. No, I don't have that.

Mr. BURNS. Now, when you first began to sell these locomotives in 1934, through the middle thirties, did you have any problem in getting the railroads to purchase these and to switch from steam to diesel?

Mr. HAMILTON. No, I wouldn't say we had any great problem. There were times when we had to employ sales effort, there is no question about that. We had to take the story to different railroads and tell them what had hapepned, what we were doing, and what was being done, and what the performance results were in different spots.

So I can't say that we didn't have some difficulty. Otherwise they would have been lined up on our doorstep to buy them, and they did not line up quite that way.

Now, we had to have a sales organization. There might be some of them around here, I mustn't leave them out. But, on the other hand, it was very small.

As I recall, our sales expense was .03 percent of our sales volume. If any of you know costs, why, you recognize how little effort we put forth.

Senator O'MAHONEY. These salesmen, Mr. Hamilton, were not in the same status as the automobile dealers in the country?

Mr. HAMILTON. No, they didn't get a commission, if that is what you mean.

Senator O'MAHONEY. Well, they were not scattered around the country furnishing their own capital, their own warehouses and their own repair shops. They were operating under the company itself?

Mr. HAMILTON. Oh, yes; they were salesmen and employees on a salary, but you understand that in the merchandising of a product of this kind, you don't do that the same way.

Senator O'MAHONEY. Oh, I know.

Mr. HAMILTON. Not in the same way that you merchandise the ordinary product.

Senator O'MAHONEY. I know you don't.

Mr. HAMILTON. And you don't sell these railroads very many things. You might sell them, or talk them into trying 1 or 2 or 3, and you might call their attention to a situation and generate some interest on their part that will result in a sale, because you know their own people, and

so forth, and you say, "You know, you have got an operation out there in Dakota that you ought to give a thought to," and get the thing generated and in motion, but you don't sell them anything.

You can't go out and sell one of these railroads 10 or 20 or 30 million dollars' worth of locomotives on fast talk. They just don't do that. They buy them, and they don't buy them unless they are convinced that they are spending their money the right way and that they can stand up in front of their directors and support their position.

So no conversation of a salesman is going to persuade them very much. They don't do that.

Mr. BURNS. Is it the practice in selling locomotives to deal with the top railroad executives, such as the president?

Mr. HAMILTON. Well, no. It works both ways, but generally what happens is this: Now, when the locomotives were first introduced and when the motorcars were first introduced, yes, we went to the president of the railroad as a rule, and told him, for this reason, that their mechanical people and their staff people were in no position to process the buying of a thing like this through their normal procedures. They couldn't take responsibility for it. They didn't know anything about it. They don't know if it will work or not.

If the old man, or the boss up here, wants to buy one, let him buy it and let him take the responsibility. So he did, but he didn't take the responsibility. He put the responsibility on the manufacturer, you see. So the manufacturer relieved everybody of responsibility, supplied him with the locomotive. The boss says, "Take this out and try it and see if it is any good, and what it will do."

That is the way we started. Now, after they had bought a few and had had some background and experience and gotten some knowledge from experience of this new type of power, why, then automatically it starts to flow, then, through their regular routine.

They have their committees; when the railroad decides they are going to buy some locomotives, they generally have a mechanical committee or power committee, as they call it. Those fellows will gather all the data together as to the experience of the locomotives in service, what their costs are, what the general records are, and probably decide on the type of power they need for the job, what kind of a locomotive it is to be, what the gear ratio ought to be, what the horsepower ought to be.

When they get all through with that, they come up with a recommendation and that floats all the way up to the top, and finally the decision is made at the top. But the recommendation is not very often rejected.

As a result, whatever the recommendation of those mechanical departments are these days, that is pretty apt to be what the president or the people making the final decision accept. That is the process.

Mr. BURNS. Now, in the middle thirties when you were putting these first diesels on the road, did the railroads have any problem in obtaining the finances to make the purchases?

Mr. HAMILTON. Oh, yes; 40 percent of the mileage of American railroads were in receivership when we started this program.

Mr. BURNS. And how did that affect your ability to sell diesels to them?

Mr. HAMILTON. Materially.

Mr. BURNS. How did you overcome that problem?

Mr. HAMILTON. You spoke about a recess here. You are taking me off up another creek now.

Mr. BURNS. Well, let's take 5 minutes for that answer.

Mr. HAMILTON. Well, that story goes back into the twenties again, or late twenties, or 1930.

Mr. BURNS. I would like to have it just from 1934 to 1937.

Mr. HAMILTON. Without getting into the background, there is no use in going into it.

The point is this: The railroads have a habit, a practice—if there are any other people in the room that have had the same experience we have had, they will agree with us—it is the practice, and a psychological fact, that when carloadings are down and traffic is down and business is down, they just do not make capital expenditures—period. And what they mean by that is an AFE, that is, authority for expenditures. That is a sacred document on the railroad.

So that when the thirties came along, there wasn't anybody on any of the railroads that I knew—not most of the railroads—any officers that had the courage to even make out or ask for an AFE, for a pencil, let alone a locomotive. It just wasn't done. If there are any railway equipment people here, they will go along with me.

Now, then, here is what we were faced with, to get off of dead center where we were in 1930. We had at that time a lot of studies that we had already made with the railroads, as to where we could apply motorcars that would save them some money, even the gasoline cars, and that is all we had to offer. But when the crash came, and the carloading curve went down, the curtain was down and everything stopped.

So to revive a lot of these deals we had in motion, we cooked up a new one, a new idea, and it was this: the railroads, as a matter of policy, have authority, as a practice, to lease locomotives, they can rent them one from another, Pennsylvania can rent them from New York Central if they need them, pay so much a day for them, and that is an ordinary operating expense, and that is the way it is done. When they get through with the locomotives, they send them back.

So we came up with this idea. We would lease them these motorcars and we would get a piece of paper from them, and the paper says this: that they will lease this motorcar for 3 years or 5 years, or whatever it is, and they will pay so much a month rent for it, no down payment, no obligation to buy it whatsoever. Any time they want to send the thing home, they can do it, there is nothing in there about that. But if they keep it, they will pay us so much a month.

At the end of the 4 years we will sell them the locomotive, if they want it, for $1.

That went into operation in 1930, and some of that paper was in the deal when General Motors took us over. I made a deal with the Cleveland Trust Co. to finance the paper, and they took it, furnished the capital for that investment. So we launched the motorcar business that way.

Senator O'MAHONEY. That was sort of a conditional sale?

Mr. HAMILTON. In effect; but legally speaking, it was not a sale——

Senator O'MAHONEY. No. You are right.

Mr. HAMILTON (continuing). Because we could not hold the railroad to anything.

Senator O'MAHONEY. You didn't transfer the title?

Mr. HAMILTON. And no obligation to pay any specified amount of money.

Senator O'MAHONEY. Oh, well, there was a lease payment.

Mr. HAMILTON. No; just a rental agreement that as long as they kept it, they paid us so much a month, but they could send it home any Monday morning if they wanted to, at any time.

Senator O'MAHONEY. But while they kept it, they would pay that amount?

Mr. HAMILTON. That's right; but no obligation to pay a specified amount.

Senator O'MAHONEY. Of course, in the sale of automobiles now, we are told that the lease period, so to speak, to use the word that you have used, is being extended, payments can be made over a longer period, and a longer period of time, and the down payment becomes less and the amount of credit that the dealer must give to the purchaser for his old car increases, so all through the country dealers are telling us, but always under an injunction: "Don't use my name."

Things are getting pretty tough. So when you speak of the tough times that your company was facing before General Motors took you over, I am inevitably reminded of the tough times that dealers are now facing in the sale of automobiles, but that is another story.

Mr. HAMILTON. It is another story, except this one point: have they used up their fat that they accumulated in these lush days they have just been through?

Senator O'MAHONEY. That I don't know. We will get to that.

Mr. HAMILTON. They must have some fat left over to work on for a while.

Senator O'MAHONEY. We will get to that.

Mr. HOGAN. Have you been talking to any General Motors dealers?

Senator O'MAHONEY. I haven't missed a dealer in the whole shebang.

Mr. HAMILTON. Ask them that question, Senator.

Mr. HOGAN. All you have got to do, Senator, is ask how much he has made for the last 5 years, then see if he is crying wolf; poverty with a ham under your arm.

Senator O'MAHONEY. When you come in, Mr. Attorney, with the dealers and we can assure them that there will be no reprisals, why, then, we will get the story.

Mr. HAMILTON. Shall I go ahead, Senator, and answer this question?

Senator O'MAHONEY. Yes, please.

Mr. HAMILTON. Now, when we reached a situation in 1936 and 1937, and our volume of production was going up and the railroads wanted the locomotives, we were faced with the problem that you have just introduced.

So I went to General Motors, and recalling the experience we had with these motorcars back in the early days—and, incidentally, we sold those motorcars at that time to probably as poor railroads as existed, and the record indicated there was never a payment one day late, never in the history of that whole transaction. So that was a good credit basis.

So I went to General Motors and told them what the problem was, and so forth, and their first reaction when I told them what I wanted to do, was very, very, very unfavorable because it didn't make too much sense to talk about selling locomotives to a railroad without any

downpayment, when it was already in the hands of receivership, and that is what I was talking about doing.

And, of course, immediately they wanted to see the balance sheet of these lines we were talking about, and I said that is not the place to look, we don't look at the balance sheet on a railroad, not under these sort of conditions. We have got another yardstick, and I told them what that yardstick was, what we would look at.

So they went along. They gave me $5 million to play with as rotating funds. So I started using that; whenever we met a condition, we would operate on this lease arrangement for many railroads.

There was one railroad, and I will tell you this story, and it can be a matter of record—there was one railroad in the hands of receivers. I know the management, knew the property, had known them for a long time, and they had changed management in the meantime, new people had come on the scene and had taken charge and had a program for rehabilitation.

That railroad at the time I am speaking of was 1937, was on the c. o. d. list for sparkplugs from us. The purchasing department, when they wanted a spark plug, then sent a man out there and they had the cash right on the barrelhead.

They changed management on that property. The management sat in my office at La Grange and went over the program for rehabilitation, the things they were going to do. I knew the individual. He was off another line. I had known him for a good many years.

When he got in his automobile, I said to him then: "When you get around in your new program to wanting motor power, call me up and I will send you whatever you need."

I eventually sent him 37 locomotives without any cash payment. Every payment was met right on the barrelhead, right on the button, every one was paid right on schedule.

Now that launches a new philosophy of railroad financing of railroad equipment. It started to expand from there, and in no time at all the railroads as they got a little money started to make downpayments on the same basis, so that reduced the interest rate, because we were charging 4½, that is the cheapest money I could get out of the GMAC group, and that was pretty good.

Well, anyway, finally when the bankers commenced to see the potential of that one, they hammered the price down to 1⅞ percent: 1.78 was the price railroads got to paying following the same broad philosophy.

It got a little more legal and they got the thing rolled up in a little different form, they got a lot of new names for it, when they got to making downpayment, but in principle that is the way this whole locomotive program finally got in motion from a financing standpoint.

Does that answer your question?

Mr. BURNS. Yes. Did the Burlington pay in cash for this first diesel?

Mr. HAMILTON. Oh, yes; lots of them paid in cash. There were not too many.

Senator O'MAHONEY. Mr. Burns, it reminds me a great deal of the financing program which the Government established in 1933 and 1934 when it established the Public Works Administration and advanced the credit and built the courthouses and the bridges, the railroad bridges and others around the country, because it had confidence that the people of the communities would respond.

Mr. HAMILTON. Right.

Senator O'MAHONEY. They took a leaf out of your book or you took a leaf out of the Government's book.

Mr. HAMILTON. Well, it worked.

Senator O'MAHONEY. It worked.

Mr. HAMILTON. That's right.

Mr. BURNS. In what year did GMAC begin this financing of the purchasing of diesels?

Mr. HAMILTON. They did not really finance them. We financed them. We underwrote the paper, but they were the ones that handled the cash.

They were the bankers, but they just sat there and went through the motions, that was all, and that began in 1936, and I would say other than a few interim deals, once in a while we still get in a situation where a financing program in a big block, the locomotives are not delivered on schedule, there is a hangover period. We sometimes use them for interim financing, but the banks handle it nowadays. GMAC is not in it.

Mr. BURNS. How long was the period when GMAC furnished the funds of this financing?

Mr. HAMILTON. Oh, 3 years or something like that, 2 or 3 years, that's all, launched it, that's all.

You would be surprised—a lot of this paper that GMAC took a lot outstanding at the rate of 4½ percent, after a third of it was paid off, the banks paid it off at a lower rate, took it right out of circulation.

Mr. BURNS. But at the time GMAC made this fund available to your division, the banks were not willing to furnish the funds to the railroads?

Mr. HAMILTON. No; they didn't know whether these diesel locomotives would last a week or what would happen to them. There was no security in a diesel for a banker at that time. He had to have it establish a record of life before they could afford to use them as collateral.

Mr. BURNS. So that this financing was essential to sell these locomotives that you were producing on this assembly line principle?

Mr. HAMILTON. No; I would not say so, because if we had not had any of the lines in receivership, the railroads that were able to pay cash in those days would have kept us rolling. We could still have sold a lot of locomotives—the Santa Fe did not need it, Union Pacific did not need it, Burlington did not need it, Pennsylvania in those days, New York Central did not need it.

It was small railroads that used it as a rule, and as time went on maybe some of the others used it, if money was cheap enough. But it was only the smaller railroads and those that were in the hands of receivers with no credit at that time that used it.

I don't think we had over, as I recall it, there was never over 25 or 30 million of that paper floating around at any one time. That was probably the peak. It helped over the hump, but it was not vital.

Mr. BURNS. That is all I have.

Senator O'MAHONEY. Mr. Hamilton, Mr. Burns, the chief counsel tells he has no additional questions to ask of you at this time, and neither do I. We have 20 minutes before the 4:30 adjournment time that I said earlier I would like to meet, and I want to invite you now, sir, you have been so ready with your responses to the questions of

counsel and myself, I want to extend to you the opportunity to make any additional statements that you desire with respect to the problem as it has been presented here today or as it has been presented heretofore.

The floor is yours.

Mr. HAMILTON. Thank you.

Senator O'MAHONEY. I am going to make an example out of you, sir, a good example.

Mr. HAMILTON. Well, thank you, Senator. I hope that I will not be a horrible example.

Senator O'MAHONEY. Oh, I am sure you will not; I am sure you will not.

Mr. HAMILTON. Those two words generally go together, you know, "horrible example."

Senator O'MAHONEY. Excellent example, sir; an excellent example.

Mr. HAMILTON. The phase that I would like to carry through, and I can do it quick and fast, I think, on this whole program, generates in my mind, to some extent, from statements made here yesterday, and things I have read in the newspapers.

Senator O'MAHONEY. Oh, now, don't be disturbed by the things you read in the newspapers.

Mr. HAMILTON. They were generated though in the hearing, that is the point. If they were just made in the newspapers it would be something different. The boys can explain about anything they like.

Senator O'MAHONEY. Just so long as they spell your name right, that is all you need to request.

Mr. HAMILTON. I would like to get the picture completed a little bit, because the inference here, and these are the two that I did not like, and I am not speaking for General Motors, I am speaking for myself because I launched this whole project. I started the Electro-Motive Co. with 1 stenographer and 1 secretary and my own money, and I have been right in the middle of that development up to where it is today.

I was president of it in this whole life, and I laid the policies down and have more or less been the guiding influence. So what has happened there is largely my guidance.

Now, when somebody tries to get in the record that the success of the enterprise was due to two artificial conditions, one was the situation wherein influence of the General Motors Corp. was one of them, and another one was a regulation established by one of the departments of the Government that gave us an advantage, and therefore because of that we dominate the business and are the controlling factors in the business, I take exception to those statements, and I will point out some of the reasons why I take exception to those statements.

As I indicated here today and as the record, when it comes out, will show, we did not go into the diesel locomotive business per se until the beginning of 1934, but back of that was 14 years of experience and development.

When we introduced our first diesel engine and diesel locomotives out of our factory, we had 6 years' specialized development and experience and engineering and research to develop an engine that would make it possible to do that.

Senator O'MAHONEY. Now you are speaking of your own company?

Mr. HAMILTON. I am speaking of all of us. It is all related together now. As far as I am concerned, they all run together. When we started on the development——

Senator O'MAHONEY. It comes segment by segment. In telling your story, you went back to the foundation of Winton and you went back to the foundation of Electro-Motive.

Mr. HAMILTON. Right.

Senator O'MAHONEY. And you have told a very logical and clear story of the development.

Mr. HAMILTON. All right.

Senator O'MAHONEY. So it divides itself into different periods.

Mr. HAMILTON. All right. I will start out in 1930, that makes my point, when we started definitely to build or to design a diesel locomotive or diesel engine, I should say, that was required for the production of our future products. We have been over that this afternoon.

Now by 1936 and 1937 we had had 6 or 7 years of investment, technical advance, experimentation, and history behind that engine, so that we had then ready to produce a complete locomotive, line of locomotives with this historical background of experience.

Senator O'MAHONEY. But not the diesel locomotive.

Mr. HAMILTON. Yes, sir.

Senator O'MAHONEY. Are we in agreement? You were not ready to produce the diesel locomotive?

Mr. HAMILTON. In 1936 and 1937 we were.

Senator O'MAHONEY. Oh, yes, but in order that the statement may be perfectly clear, it was not until you went to General Motors.

Mr. HAMILTON. We went to General Motors in 1930, so that is where I am starting.

Senator O'MAHONEY. But your background was long prior to that.

Mr. HAMILTON. Oh, yes; I covered that a moment ago. But I am getting right down to a specific point now, that we started specifically on the diesel engine, out of which this whole development has really taken place, economic development involving the transition from steam motive power to diesel motive power on the railroad.

We started that development specifically in 1930, and by 1936 and 1937 we had a commercial product that we were willing to put in the hands of buyers and guarantee it.

Now, then, by the beginning of the war we were well advanced in our tooling, in our manufacturing facilities, and in the design of all of our models. We had switching locomotives of two sizes: we had what we call a semi-all-purpose type or transfer locomotive. We had a passenger locomotive of different sizes, and we had developed a freight locomotive and it was in production, well into production, so that we had a historical background of that development.

Now, figures that were given out here yesterday indicated that at the beginning of the war rules were established that handicapped our competitors to our advantage.

Here are a few figures we got together that I would like to review that don't seem to bear that out. Now, in the first place, all of our models had been designed, developed, tooled and were in production and had been in use sometime before the war began. I am dealing now here with percentage figures of the total diesel locomotives.

In 1940 the record shows that we sold 67 percent, and when I say "sold," I am not talking about orders, I am talking about deliveries.

There was a sheet here that I was looking at a little while ago that was talking about orders. Well, orders don't mean anything in our books because a lot of them are canceled, never filled, so we are talking about shipments.

In 1940 GM had 67 percent of the business and their competitors 33. In 1941 we dropped to 57 and they went up to 43; 1942 we dropped to 53, they went up to 47; in 1943 we dropped to 40, they went up to 60; we dropped in 1944; we had 50, they had 50. 1945 we had 51, they had 49; 1946 we had 65, they had 35; 1947 we had 62 and they had 38.

The point I want to make is this: that if the advantage we were supposed to have because we were concentrating on freight locomotives and our competitors were concentrating on switching locomotives, then why doesn't their advantage continue on out and beyond the war based on the running starts they had in the switching locomotive business during that period, because the record shows very definitely that they had a tremendous advantage?

We were not making any switching locomotives at all, and they were in high production on switching locomotives. In fact, the record shows that back in 1940 their switching locomotive production—or is it 1941?—their switching-locomotive production was up almost equal to ours, so that they knew how to make them, they had all the facilities for making them, and they went into the war with just as good manufacturing facilities apparently for making diesel locomotives as we had.

Now, then, they were running under a sheltered position on the switching locomotives and we were running under a sheltered position on freight locomotives. It is true we had built some freight locomotives so that by the end of 1942, which is when we were shut down or taken over in effect by the Navy, the other people had people putting war material into their plants, too, and we had them in our plants, in our case it was the Navy and we had to build engines and take over to supply power for the LST program, which meant all of our production plus an expanded production. So for the first half of 1943 we did not have any capacity, engine capacity, for locomotives at all.

Now, then, the net result in there was that in 1942 General Motors production of switching locomotives was at 116, next year it was 15; 1944 it was zero, and 1945 we built 39.

Now, in freight locomotives we had 2 in 1940; 47 in 1941; 96 in 1942; 184 in 1943, and then the material situation was freed, we were given the necessary material to build up the capacity, we met our Navy requirements, and we were permitted to move ahead.

So our total production in 1944 was no switch engines, no passenger locomotives, but 500 freight locomotives. Now, the competition that year built 315 locomotives, evidently representing their total capacity. So I fail to see a contention that we had any advantage arising out of the war regulation confining us to freight locomotives.

Senator O'MAHONEY. In fairness, Mr. Hamilton, as I recall the testimony of Mr. Bruce Bromley yesterday, who is the attorney for the American Locomotive Co., he said that in his opinion the WPB

order which gave you the clear signal in the locomotive field was in the public interest; it was the proper thing.

Mr. HAMILTON. There is no argument about that.

Mr. HOGAN. That statement came kind of late, Senator, though. The implication had been passed out before that, and I think he realized they couldn't support the implication, so he made the statement that was different from what his client said.

Senator O'MAHONEY. We have the record before us, and it was in response to one of my questions that he made the statement to which I have just now referred, so that is all on the record, and I don't know that Mr. Hamilton needs to be offended by that.

Mr. HAMILTON. I want to say this here. I contend that the success of this enterprise, Electro-Motive division of General Motors, was due to advance engineering, advance planning, in some cases running as high as 6 to 7 years ahead of the product completion, and proper engineering and planning of the product itself for the market, and high efficiency in production to bring the product up to as high a possib'e quality at the lowest possible price.

Those are the factors that created a locomotive that the American railroad managements bought in preference to our competitors.

Senator O'MAHONEY. Without denying any one of those assertions on your part, and I wouldn't want to—do you want to make another statement?

Mr. HAMILTON. Yes, just one more. I want to put this in the record as an indication or proof that this division did a good job, whether I was there running it or not.

The record shows, our figures show, that the current selling price of our locomotive per pound is 31 percent above what it was in 1940 and I think everybody in the room knows what the price level change has been across the board for shoes, for this instrument [indicating] for your milk and for every other item that enters into daily living, probably on the order all the way from 80 to 150 percent.

We held the increases to 30 percent and we absorbed an increase in labor of 162 percent in that length of time, and an 80 percent increase in materials. That is a record, manufacturing record, behind this story that produced the type of a locomotive that dominates the American scene, there is no question about.

Senator O'MAHONEY. Well, I would be the last person to deny it, sir. I am not here to defend what any of our witnesses say, but nevertheless there is another factor in this case, and that is the factor which you brought out, that your company, the one that you so ably developed, making the gas-electric engine, was unable to carry out the new potential which you say and which you explained to Mr. Kettering.

It was carried out very successfully, so successfully that the railroads of America adopted it quickly, because General Motors had the capital and the willingness, through Mr. Kettering's leadership, to buy your company, absorb your company and make it a wholly owned subsidiary, and undertake the vast expenditures necessary to perfect the development.

Let us assume that it was completely perfected. To my mind it only demonstrates what has been clear on the record of the history of the development of industry in the United States.

When the Interstate Commerce Commission was first established, it was established because the railroads had extended beyond State boundaries and were no longer capable of being regulated in the public interest by the States. There was no partisan division at all about the establishment of the Interstate Commerce Commission to regulate the railroads.

When I was a secretary or a year after I had graduated from law school after I had resigned as secretary to my predecessor, Senator John B. Kendrick, a bill which he introduced and which Senator Kenyon, W. S. Kenyon of Iowa sponsored also, it was known as the Kendrick-Kenyon bill—Kendrick was a Democrat, Kenyon was a Republican. It was a bill to give the Secretary of Agriculture power to regulate the stockyards and the packinghouses of the United States.

The allegation on which the bill was based was that the packinghouses had complete control of the livestock industry, that they could make the price for the producer in the stockyards which they owned and dominated, and that they could make the price for the householder in the retail establishments which they held.

That bill was enacted in May 1921. It was signed by President Warren G. Harding. It was a bill which gave the Secretary of Agriclture more power to regulate a business than was ever given by Government before or I think since.

So what this country is faced with, and I think there can be no doubt about it, is this plain fact: that a growing segment of the national commerce, now practically all of it, is being dominated by a small number of corporations in almost every major industry which are created by the States, which have no power to regulate in the public interest, so that the regulation of commerce on which the life of every inhabitant of this United States depends is now in the hands of management, and we have an economic situation which is awfully different from the political situation.

In the political field we have the 48 States. In some cases these States attempt to regulate some of the businesses that come in. American Telephone & Telegraph Co. is regulated by the States, and it is also regulated to some extent by the Federal Government.

Bureaus and commissions and the Secretary of Agriculture have been given power to interfere in business to a degree never before accomplished. And the problem that is before this committee is the problem of assessing not the narrow responsibility for immediate or diverse acts, but the scheme of things by which our commercial regulation and our political regulation shall be on the same field.

Now this is at the heart, as I see it, of the problem that affects the world; the Communists upon the one hand, the Fascists upon the other, have each said that the control has got to flow from political management at the top.

I firmly believe that the greatness of America has grown from the fact that we have heretofore kept business and economics completely free, so we want to know in assembling the facts in this committee to what extent bigness itself, without any abuse at all, may be producing a concentration which will destroy inevitably the political liberty of the people.

Now that may to many people seem to be an exaggarated statement. I don't think it is, because I have watched the development through all these commissions and boards for 20 years.

I remember very well when, way back in the administration of William Howard Taft as President, the same problem that is before us now was before the Congress then. Under his direction George Wickersham, Attorney General of the United States, wrote a bill to provide for voluntary charters for business in the national field.

It was never passed but it was introduced, and as it happened, strangely enough, it was introduced by a Senator from my State who at that time was the chairman of the Judiciary Committee, Senator Clarence D. Clark.

This thing isn't a recent development, it is not a development of diesel locomotives at all. It is a development that comes from a thousand different angles, and it has shown clearly that there is a split, we have almost a split personality between political government and ecnomic government, and so far as the present acting chairman of this subcommittee is concerned, his only purpose is to lay the facts out on the table, and I want to compliment you again, sir, most highly for your willingness and your great ability to tell the story as you have told it here this afternoon.

Mr. HAMILTON. I thank you, Senator.

Senator O'MAHONEY. Thanking you, sir, for your evidence this afternoon, the committee will stand in recess until 10 o'clock Tuesday next.

(Whereupon, at 4:35 p. m., the subcommittee took a recess to reconvene Tuesday, November 15, 1955, at 10 a. m.)