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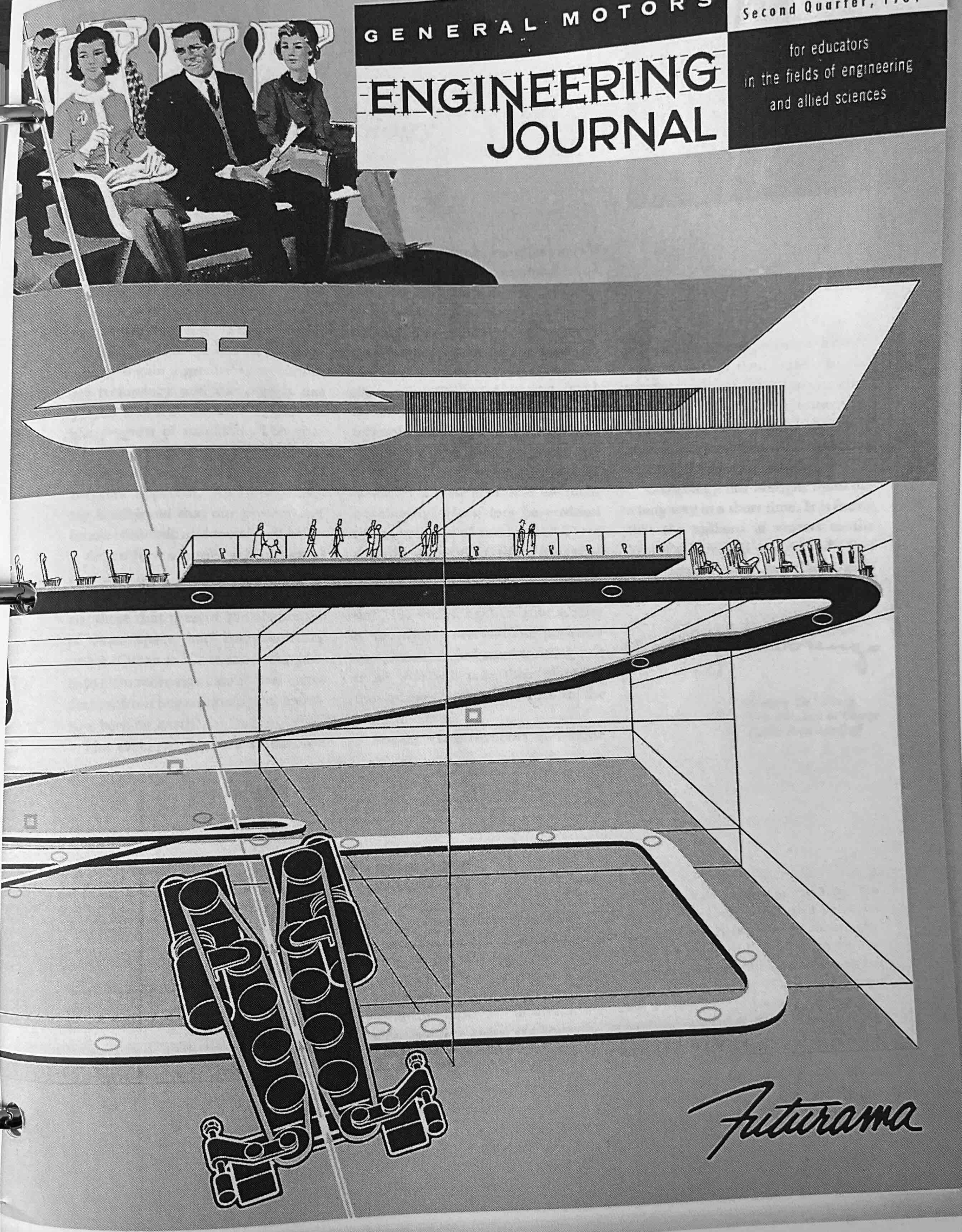
GENERAL MOTORS ENGINEERING JOURNAL

for educators in the fields of engineering and allied sciences



A Symbol of Technology

THE 1964-65 New York World's Fair portrays, through its exhibits, the potentialities for progress on a shrinking globe in an expanding universe. Many of the exhibits provide visitors the opportunity to gain a greater appreciation for technology and the part it has played and will continue to play in the progress of mankind. The vital role of the engineer in this progress, which too often is taken for granted, becomes apparent. An understanding is achieved that our present and future economic and social well being is dependent on our technological capabilities.

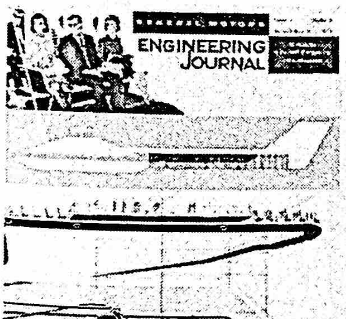
Included among the Fair exhibits are those that present the challenges of outer space and interplanetary travel. Other exhibits show the perhaps even more significant challenges that confront our technological know-how here on earth.

The General Motors Futurama exhibit, for example, examines man's future in the remaining natural frontiers on this planet—the oceans, jungles, mountains, deserts, and polar regions. The exhibit does not deal with fantasy. Based on the theme of mobility, it realistically portrays what the not-too-distant future might hold for us. How is man readying himself technologically to meet the challenges of these varied areas to make life better? Can he overcome the natural obstacles of these areas and use them beneficially? How does he envision the metropolis of the future? These are questions that the Futurama exhibit attempts to answer. The final answers, however, will depend on the skill, ingenuity, and creative ability of future engineers—those presently completing their formal training and those who will take their places in the colleges and universities in the years to come.

Engineering students and those contemplating engineering as a career would find it to their benefit to visit the Fair and see what today's engineers are planning for tomorrow. Because tomorrow will be their field of endeavor and they will be working to fulfill the dreams of today.

Technology has brought mankind a long way in a short time. It is fitting that the millions of visitors to the World's Fair will see exhibits that recognize not only its achievements but also its potential.

Anthony De Lorenzo,
Vice President in Charge
Public Relations Staff



THE COVER

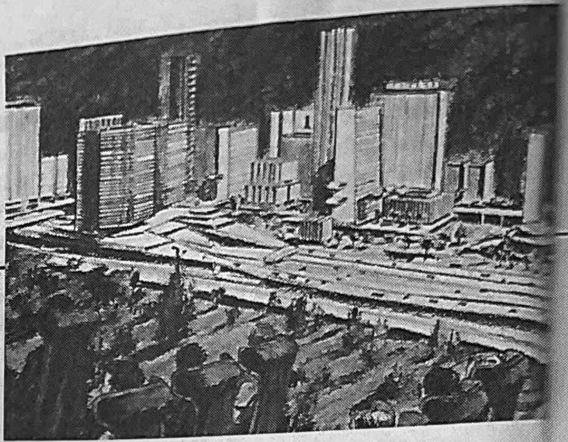
This issue's cover design, by artist Ernest W. Scanes, depicts the General Motors Futurama ride at the 1964-65 New York World's Fair. The white silhouette on the front cover represents the GM Pavilion (shaded area is the Futurama ride section).

The continuously moving ride follows a closed loop track. Visitors board and leave the ride's 463 three-passenger seats via moving belt walkways. The ride path is approximately 1,850 ft long and moves through several elevations. Each ride cycle takes approximately 15 minutes.

Shown on the front cover is one of the drive units that provide motion to the ride. The location of these units is indicated by circles on the ride path. Brake units of similar construction are indicated by squares. A vertical belt that is channeled within the ride track and attached to the bottom of the seat chassis passes through each drive unit. It is driven forward much as a towel is forced through the wringers of a washing machine. A smooth and silent ride motion is provided.

All engineering and design work for the GM exhibit, including the ride, the Pavilion, and product displays, was the responsibility of the GM Styling Staff.

A Design Summary of the GM Futurama II Ride at the 1964-65 New York World's Fair



Visitors to the General Motors Pavilion at the 1964-65 New York World's Fair will have an opportunity to view Futurama II—GM's interpretation of some of man's future achievements. Viewers of Futurama II will be passengers on a unique ride system, conceived, designed, and developed by the GM Styling Staff's Industrial Design Studio. The ride, which features an original drive mechanism, is a continuous closed loop system and moves through several elevations. Designed to provide its passengers with a quiet, smooth ride accompanied by a synchronized sound system, the ride is rated at a capacity of approximately 65,000 people per day.

One of the most successful exhibits at the 1939 New York World's Fair was the Futurama exhibit in the General Motors Pavilion. This exhibit, the largest scale model that had ever been built at that time, depicted the changing face of the city and the countryside with emphasis on the development of highways and automotive transportation in this country. To view the exhibit, visitors rode a 600-seat conveyor system with a capacity of about 30,000 passengers per exhibit day. When the Fair closed on October 27, 1940, some 9.6 million people had ridden through the Futurama. This was over 21 per cent of the total Fair attendance during the 1939-1940 period of operation.

The success of the Futurama was due to two main ingredients: (a) recognition of the natural curiosity of man to see what the future holds for him, and (b) the provision of a conveyance system for the visitors, not only for the sake of an organized and controlled movement of people but also for the refreshment of the footsore and the weary. Today, these ingredients continue to remain a basic requirement for large scale presentations. The use of a ride in eight major pavilions at the 1964-65 World's Fair attests to its popularity.

In 1939, the focal point of interest was mobility in the United States. Today, it is mobility on a global scale. In preparing for the 1964-65 exhibit, General Motors decided to examine "Man's Achievements on a Shrinking Globe in an Expanding Universe," survey the great changes to come, and bring this story to the people. As in 1939, the cited quotation from the central theme of the New York World's Fair represents in part the theme of the present GM exhibit.

Similar to the 1939 exhibit, Futurama II is based on the concept of a large scale diorama and means of transporting people to view it. This time, however, spectators do not merely look at the changing scenes but experience movement through the varied environmental settings used to tell the story.

Visitors to the Futurama II will board a ride for a journey into the future. After a brief introductory prologue, the ride will carry them through space to the moon to witness man's activity and mobility on that satellite. To remind one of the unconquered frontiers on earth, they then are brought back to the continent of Antarctica, where the once barren land is seen to serve man's quest for greater knowledge of the world in which he lives. The journey continues towards the ocean floor, which is being both industrialized and inhabited by man. From underseas, visitors enter a tropical jungle, then move on through mountains and desert, seeing how these regions are transformed into productive lands. Finally, they are ushered to the approaches of a city, with a view of tomorrow's urban life. This briefly describes the Futurama II show as seen from the ride, which takes nearly 14 minutes of viewing time.

Ride Design Posed Unique Problems

In October 1960 the Industrial Design Studios of General Motors Styling Staff, comprised of industrial designers, mechanical, electrical, and architectural engineers, as well as modelers, was assigned the responsibility for the overall design and coordination of the GM Pavilion, the Futurama show and ride, and product displays and exhibits at the 1964-65 New York World's Fair. The experience of this group in creating and engineering large GM-sponsored shows included the Chicago Powerama, which covered 20 acres, and the GM Motoramas, with over 100,000 square feet, which toured the country from coast to coast. It is interesting to note that the 1964-65 Futurama assignment was based on competition in which nationally prominent architectural and exhibit firms and the Industrial Design Studios of General Motors Styling participated.

The spectator conveyor used in the 1939 Futurama was carefully re-examined. It was found that a similar system would not yield the passenger carrying capacity required for the Futurama II ride. While the 1939 conveyor carried 30,000 people per day over a 1,568-ft track, projected attendance at the 1964-65 World's Fair called for a daily ride capacity of about 65,000 people over a track length of 1,850 ft, with ride speed remaining nearly the same. A number of seats were displaced by electric drive motors on the 1939 ride, which reduced maximum passenger capacity. This feature was considered unacceptable for the Futurama II ride.

A study of many commercially available conveyor systems showed that all had one or more of the following objectionable features:

- Excessively noisy and jerky operation
- Problems in driveline take-up and tension
- Poor speed regulation
- Questionable safety provisions
- Excessively bulky drives that could not be concealed within a predetermined cross section of roadbed structure.

By ROBERT F. SMITH
and LOVA KHORAM
General Motors
Styling Staff

New drive mechanism powers Futurama II ride silently and smoothly

Other methods of propulsion also were considered, including both suspended and supported monorail systems, conventional four-wheel vehicles using traction motors integrated with front or rear axles and powered either individually or coupled in multiple units, the friction roller drive principle, air supported vehicles, and the linear electric traction principle. In each case, either excessive power requirements, incompatibility with basic ride design criteria, or simply too high a cost ruled out a selection. The problem finally evolved into one of developing an entirely new passenger conveyance system that would embody the following features:

- Complete operating safety
- Quiet, smooth, and reliable operation
- Ultimate speed regulation with provision for varying the speed of the system, if needed
- Ease in adjusting or take-up of any developed slack as in the case of driveline conveyors
- Flexibility to negotiate turns of a given radius and various degrees of climb and descent
- A drive mechanism not to exceed given parameters, dictated by purely aesthetic considerations and kept to a workable minimum
- Maximum passenger-carrying capacity over a set track length
- Reasonable economy in its construction, operation, and maintenance.

The path of the Futurama II ride was established as a closed loop with a pattern of turns extending over varying elevations. After the ride path was established, the Industrial Design Studios approved an engineering proposal of a steel roadbed structure that would support rolling loads over a maximum clear span of 30 ft. This led to the consideration of an in-the-floor type conveyor that could be fitted within the given parameters. If a commercially available chain conveyor were used it would have to include the following modifications:

- Precision machined chain to eliminate the need for take-up due to "wear-in"
- Smooth and quiet operation of the chain and towing attachments in the conveyor track
- Rubber faced rollers to provide chain guidance in the horizontal and vertical planes to eliminate metal-to-metal contact noise
- A reduction in the size of the conventional chain drives to fit within the approved roadbed structure.

At meetings held with major conveyor manufacturers, agreement was reached on the reliability and economical operation of the proposed conveyor system. Considerable concern was expressed, however, about how chain wear take-up, smoothness of ride, and elimination of chain noise could be accomplished. No practical solution to these developed.

Unique Conveyance System Developed

It became necessary, therefore, for the Industrial Design Studios to design and develop an entirely new type of conveyance system. The result was the novel concept of a vertical belt friction drive.

The principle involved in the new design can best be explained by describing the Futurama II ride system. Essentially, the ride conveyance system consists of the following:

- Roadbed structure, or the ride track
- Driveline
- Drive and braking drive assemblies
- Electrical control system
- Passenger seat and chassis assemblies
- Sound system
- Moving belt walkways for loading and unloading passengers.

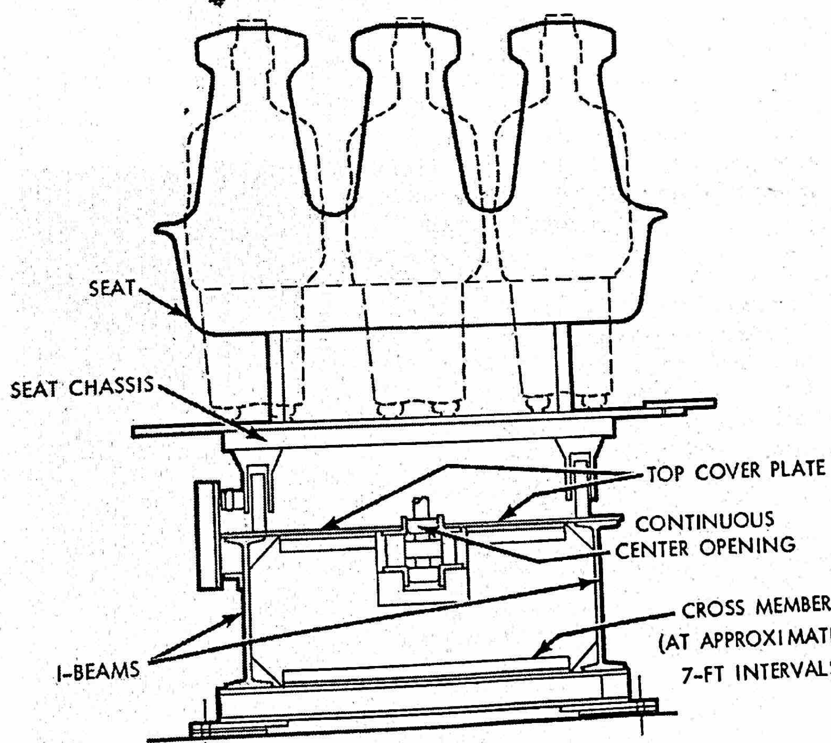
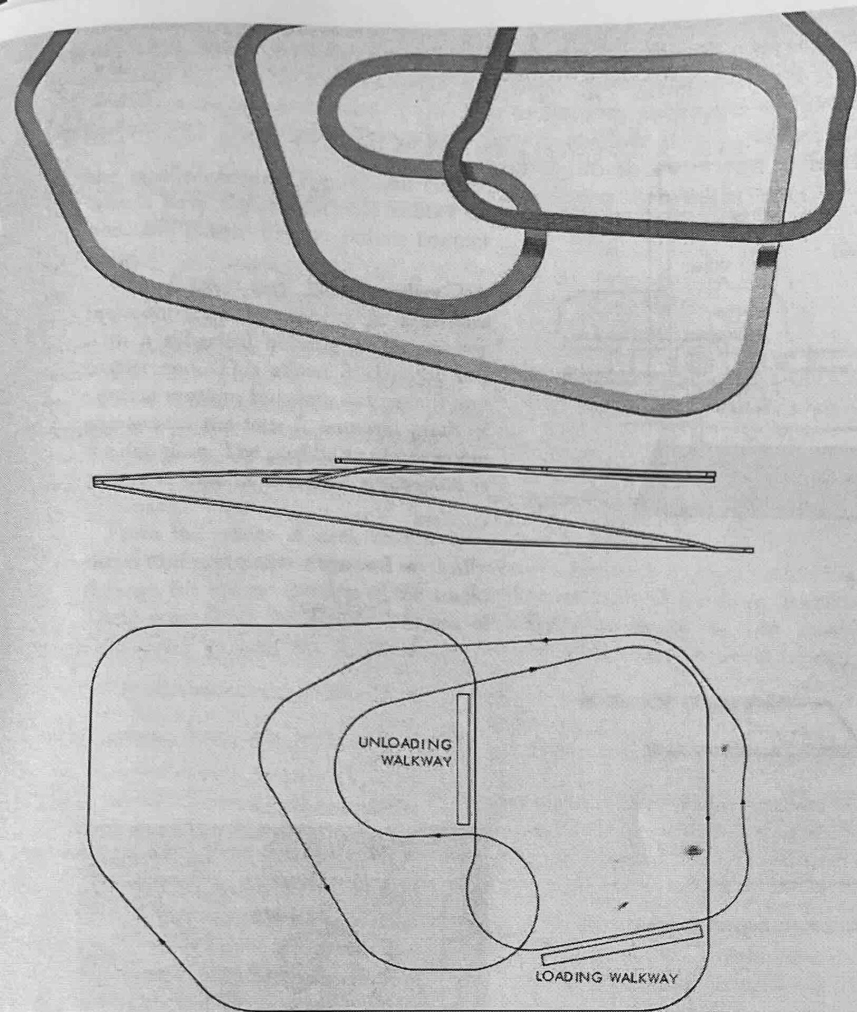
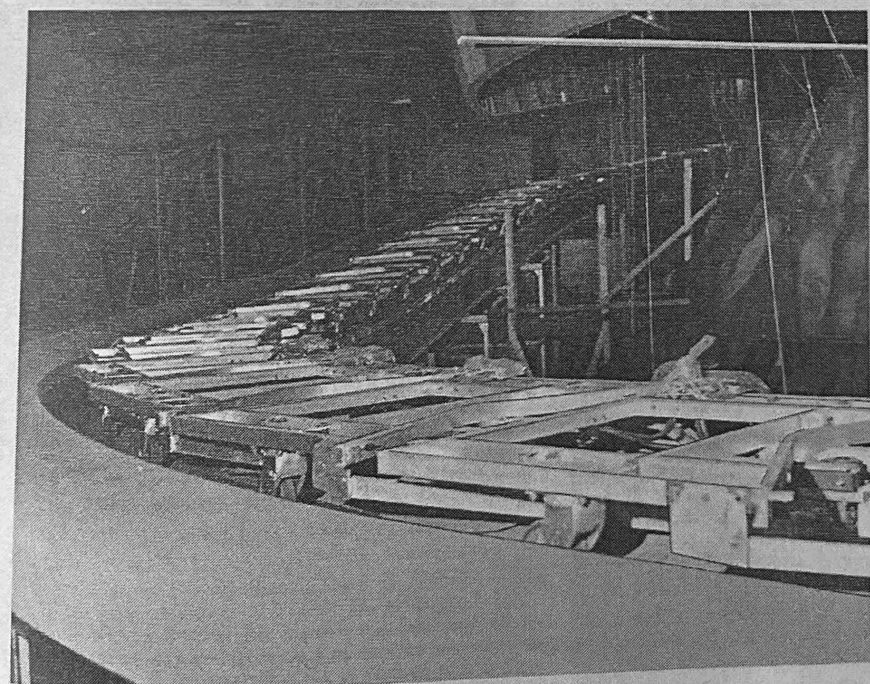


Fig. 1—The Futurama II ride track, shown in this cross section drawing, consists of two parallel 18-in. steel I-beams spaced 44 in. apart. The I-beams are topped with a 1/4 in. steel plate having a continuous center opening.





Ride Track

A typical cross section of the Futurama ride track (Fig. 1), approximately 1,850 ft in length and forming a closed loop with a number of turns and varying elevations, is made up of two parallel 18-in. steel I-beams spaced 44-in. apart. The beams are covered by a 1/4-in. steel plate with a continuous center opening. The I-beams are joined at approximately 7-ft intervals by cross members. The continuous center opening of the track is formed by four steel angles that support and guide the driveline. These are imbedded into and reinforced by the track structure.

The track elevation differential is 35 ft—10 3/4 in., with turn radii of 28 ft and 32 ft, and minimum and maximum ascent and descent angles of 7° and 7°-12′, respectively (Fig. 2).

The track structure is supported at the base by vertical steel columns, or frames, resting on the basement concrete floor at the lower levels and the building structure at the upper levels. The track support structure is isolated from the building structure by sound and vibration isolating material.

A service walkway (Fig. 3) is located adjacent and parallel to the track throughout its entire length. The walkway is supported by the track supporting structure except at the 46-ft elevation, where the building floor beams are used for this purpose. The service walkway facing, which is No. 10 gage steel plate with a non-skid surface, includes covered hatch openings for entry into drive service pits wherever the track rests directly on the basement concrete floor. In locations where the track elevation is considerably above the floor, drive assemblies are serviced from a maintenance walkway hanging from the underside of the track structure.

Driveline

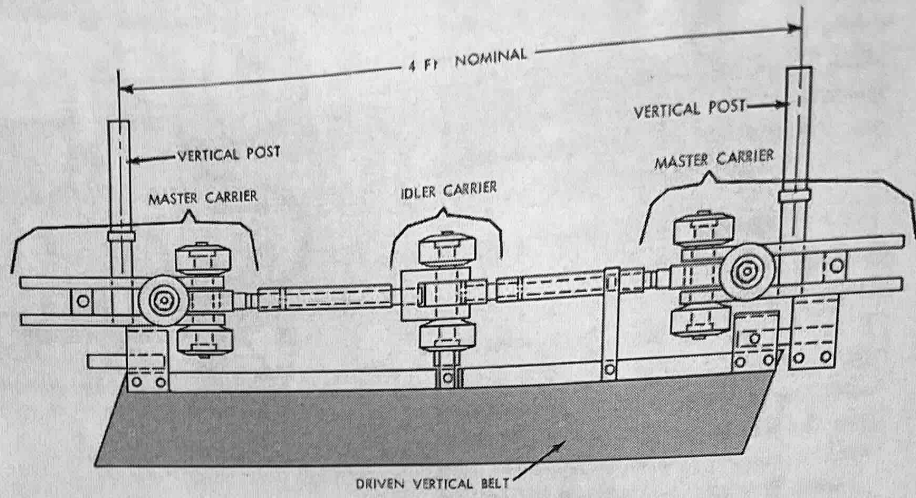
The driveline of the Futurama ride is a closed loop assembly approximately 1,850 ft long. It consists of 463 eight-wheel master carriers spaced four ft apart and an equal number of two-wheel idler carriers spaced midway between

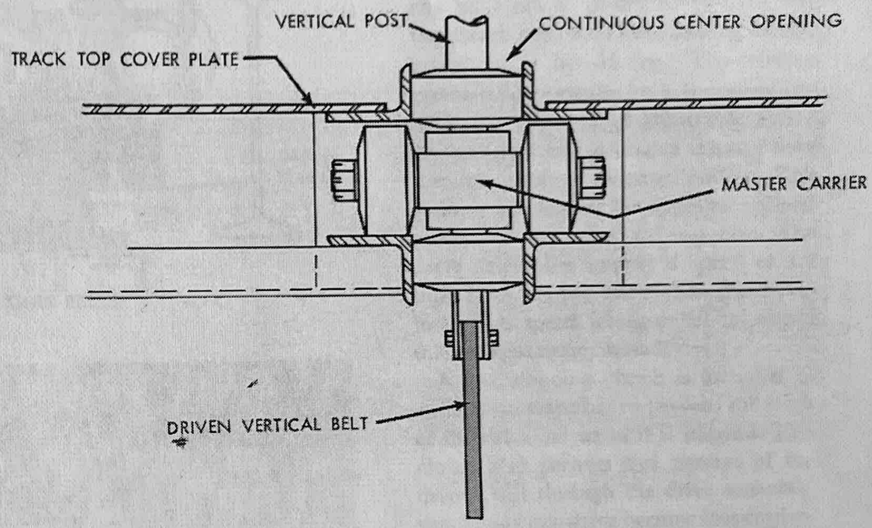
Fig. 2—The elevation and plan of the track are shown here by a perspective drawing. The photograph shows the track descending from a higher to a lower elevation. In this photograph, taken during construction of the ride, the seat chassis are shown as installed on the track.

the master carriers (Fig. 4). All carrier wheels have either neoprene rubber or urethane plastic tires to reduce contact noise.

The master and idler carriers are interconnected by adjustable drawbars with a spherical bearing at the master carrier end. This allows horizontal and vertical motion, but does not permit any changes in the four-ft nominal pitch of the driveline. The possibility of telescopic action in case of driveline separation is eliminated.

From the center of each master carrier, a steel post projects upward vertically through the center opening of the track. These posts serve the double function of





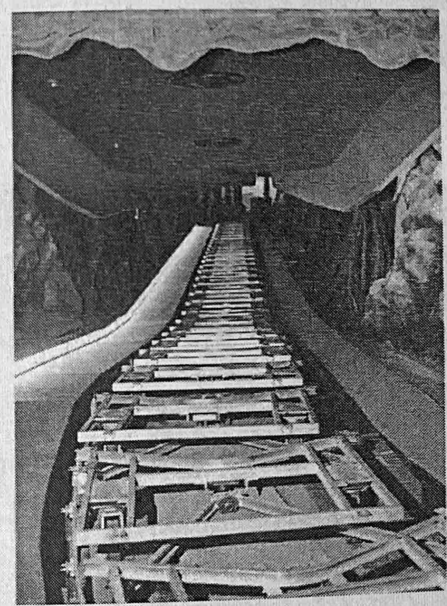


Fig. 3—A service walkway parallels the entire length of the track. This walkway is automatically lighted in case of emergency, as shown in this photograph taken during construction. Cardboard dust shields, used temporarily during the construction period, appear over the continuous center opening of the track.

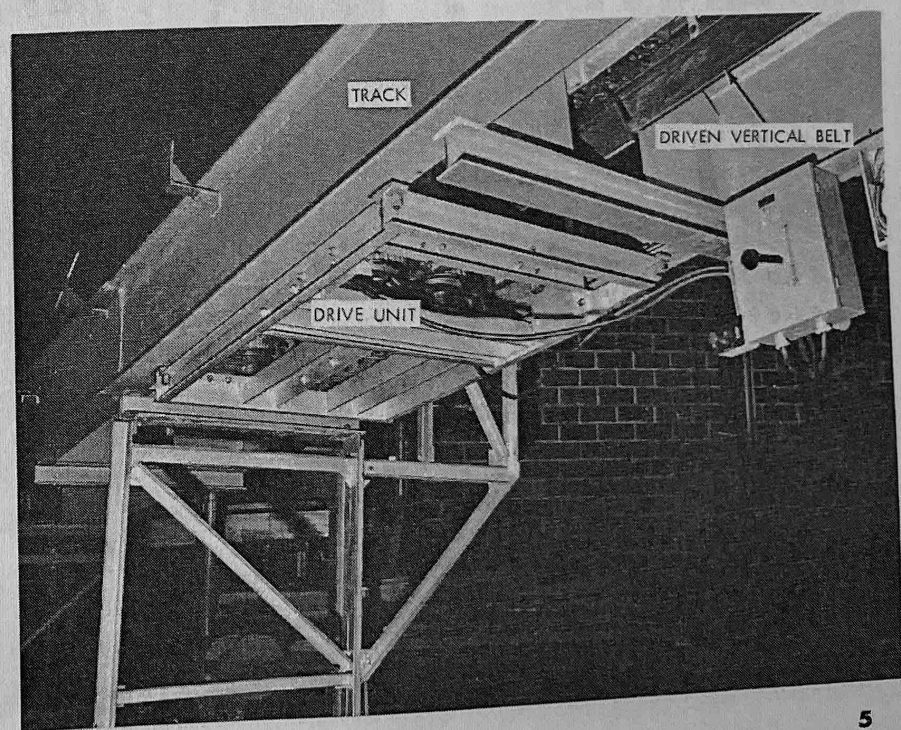
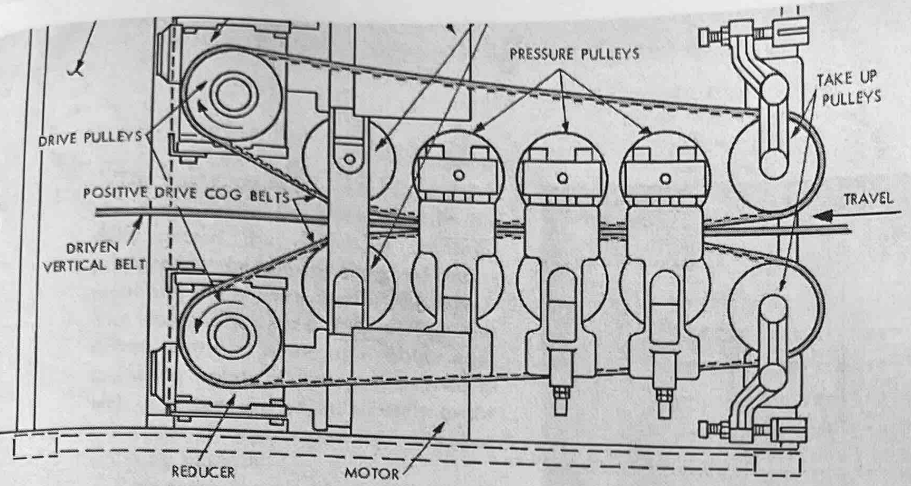
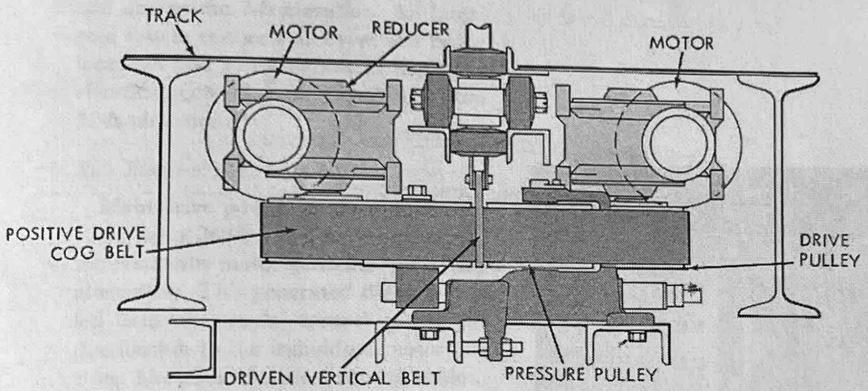
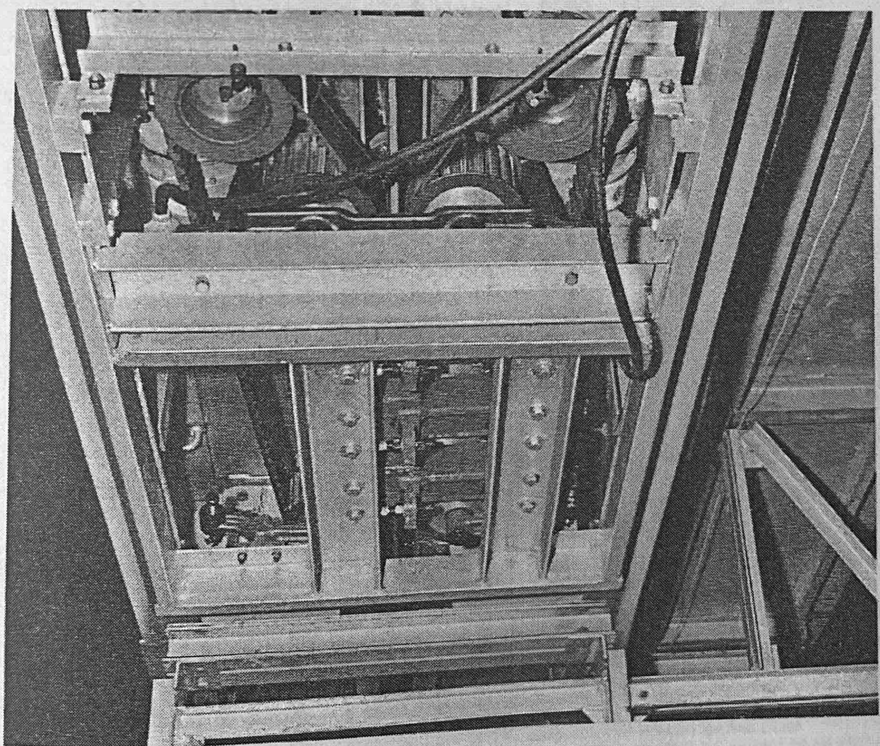


Fig. 4—The driveline consists of 463 eight-wheel master carriers spaced four ft. apart. An equal number of idler carriers are spaced midway between the master carriers. This train of carriers moves in the center of the track (Fig. 1). A vertical post projects upward from each master carrier to secure and pull a passenger seat chassis. Projecting downward vertically from the carriers are sections of belting, which are driven by the drive assemblies and which impart motion to the carriers and seat assemblies (Fig. 5). The drawings show side and cross section views of the driveline. The photograph shows an underneath view of the driveline installed on the track.







towing and guiding the 465 three-passenger seats of the Futurama ride. Attached to the bottom of the carriers, in a vertical position, are sections of fabric reinforced rubber belting, 1/2 in. thick, 7 in. wide, and approximately 4 ft long, to which driving effort is transmitted by 47 drive assemblies. In addition, four braking drives located on the downgrades are used to reduce drawbar tension.

Drive and Braking Drive Assembly

The drive assembly (Fig. 5) consists of twin 230-volt d-c motor-reducer combinations, each rated at two hp for a total of four hp per drive assembly. Each combination drives an endless positive-drive cog belt at a speed of 123.5 ft per min. The motor-reducer combinations are located directly opposite each other, separated by the 1/2-in. thick driven belt attached to the bottom of the driveline. The flat sides of the two positive-drive cog belts run in pressured contact with the driven belt, thus transmitting driving power to it by friction. The contact pressure between the belts is maintained by the application of adjustable spring pressure radially to one of the cog belts through its three pressure pulleys. This pressure acts against the oppositely placed pulleys of the other driving belt. The drive assemblies impart a speed of 1.4 mph (123.5 ft per minute) to the driveline. This speed is regulated to within 0.3 per cent noncumulative.

A backstopping clutch is included in each drive assembly to prevent roll-back of the driveline when it is stopped. This clutch also permits free passage of the driven belt through the drive assembly, should any one drive become inoperative.

The braking drive assembly is similar in construction to the regular drive assembly except that each motor is wired to provide dynamic braking for reduction of drawbar tension on the downgrade and no clutches are used. The braking drives are driven by the driveline, which causes their motors to act as generators. A resistance bank dissipates the generated power.

Fig. 5—Driving force is imparted by friction to the vertical belt by drive units which include two endless positive-drive cog belts. These belts drive the vertical belt in the same manner that a clothes wringer forces a towel through its rollers. The drawings show the arrangement of the drive belts, pulleys, motors and reducers in relation to the driven vertical belt. The photograph shows a view from below a drive unit installed on the track.

The operating noise level of the drive and brake assemblies does not substantially exceed that which is normally produced by the rotating electrical equipment and the reducer used in the drives. The contact between the driving and driven elements is through rubber and, to further isolate vibration, the drives as well as brakes are bolted securely to the track bed through sound and vibration isolating material.

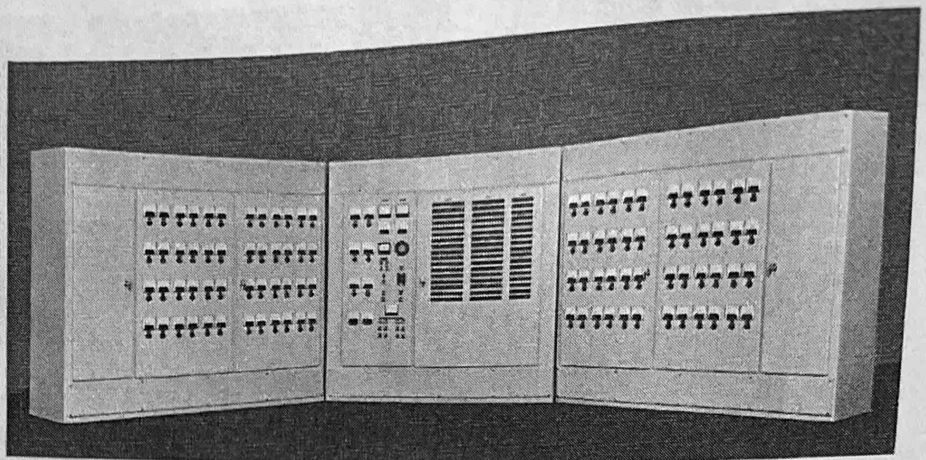
Easy access is available to all drive and brake assemblies, including two driveline service areas, one at the 46-ft elevation and one at the 7-ft elevation. An intercom system connects all drive and brake locations and service areas to the main electrical control panel located at the 31-ft elevation.

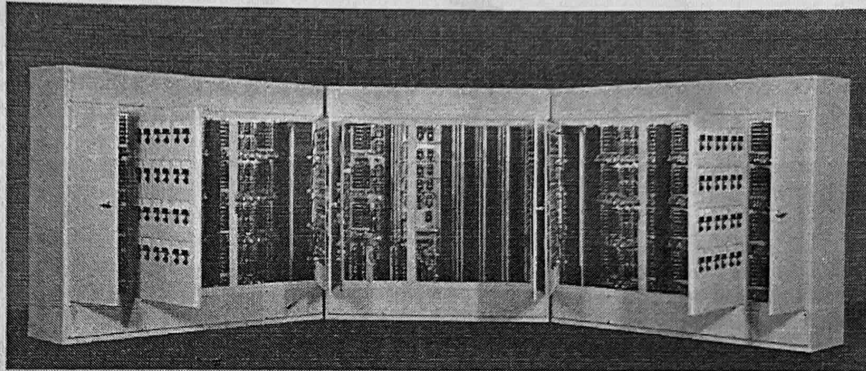
Ride Electrical Control System

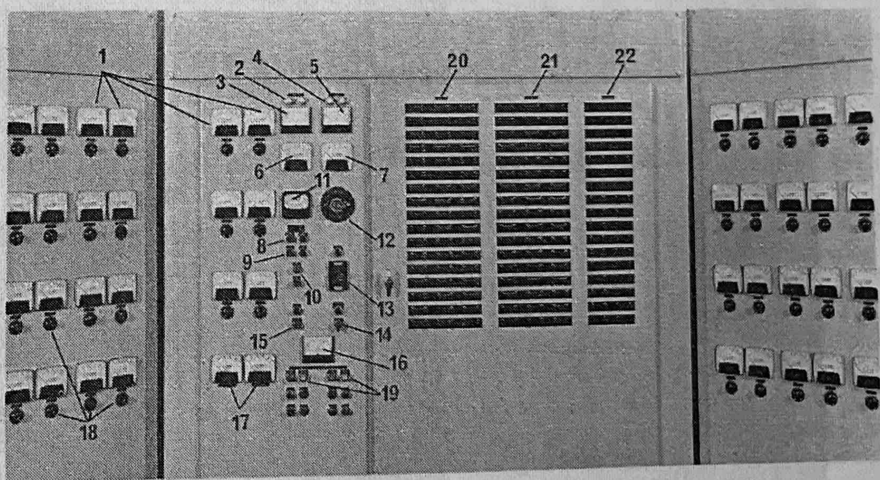
Main drive power for the ride is provided by a 240-kw d-c motor-generator set. A standby motor-generator set is used alternately. This generated d-c power is fed into the main control panel for distribution to the individual motor circuits. The main electrical control station, consisting of three panels, is located in the ride control room at the 31-ft elevation (Fig. 6). The panels continually indicate the operation of drive and brake assemblies, the two moving belt passenger loading and unloading walkways, and the motor-generator sets.

Ride speed is controlled by regulating the armature current in the drive motors. This speed is infinitely variable to a maximum of 1.5 mph, although normal operation calls for 1.4 mph. Control of individual drive motor field windings is used to trim each drive for pulling its share of the load. A Selsyn control system, with its signal generated by the moving driveline belt, regulates the ride speed with an accuracy of 0.3 per cent. The moving belt walkways and the ride are synchronized to move at the same speed.

The operator at the control panels monitors the overall operation of the ride, and is the only person able to start it. The ride may be stopped, however, by actuation of emergency stop buttons







1 - INDIVIDUAL DRIVE MOTOR AMMETERS
2 - DRIVE MOTOR ARMATURE GROUND LIGHTS
3 - VOLTMETER INDICATING D-C VOLTAGE TO ALL DRIVE MOTOR ARMATURES
4 - DRIVE MOTOR FIELD GROUND LIGHTS
5 - VOLTMETER INDICATING D-C VOLTAGE TO ALL DRIVE MOTOR FIELDS
6 - AMMETER INDICATING TOTAL ARMATURE D-C CURRENT INPUT TO ALL DRIVE MOTORS
7 - AMMETER INDICATING TOTAL FIELD D-C CURRENT INPUT TO ALL DRIVE MOTORS
8 - MOTOR-GENERATOR "ON" LIGHTS
9 - MOTOR-GENERATOR "OVER TEMP" LIGHTS
10 - MOTOR-GENERATOR "START-STOP" BUTTON
11 - RIDE SPEEDOMETER
12 - RIDE MANUAL SPEED SETTING RHEOSTAT
13 - RIDE MAIN START BUTTON
14 - RIDE MANUAL-AUTOMATIC SELECTOR SWITCH
15 - DRIVE MOTOR OVERLOAD RESET SWITCH
16 - MAIN INCOMING A-C SUPPLY VOLTMETER
17 - LOADING AND UNLOADING WALKWAYS AMMETERS
18 - DRIVE MOTOR FIELD TRIMMING POTENTIOMETERS
19 - LOADING AND UNLOADING WALKWAYS FORWARD-REVERSE BUTTONS
20 - DRIVE MOTOR "OVERLOAD" LIGHTS
21 - DRIVE MOTOR "ON" LIGHTS
22 - EMERGENCY STOP SWITCH LIGHTS

Fig. 6—The main electrical control station consists of three control panels. The panels distribute power to the individual drive units and the two moving belt walkways. Ride speed is both automatically and manually controllable from the main panel, and instruments on the panels indicate the performance of each drive unit.

Fig. 7—Each of the 463 seats accommodates three passengers. Each passenger headrest contains two speakers connected to a sound reproducing unit (Fig. 9) located beneath every third seat. The seat is set on a carpeted platform and is attached to a steel chassis (inset).

located strategically within the reach of authorized personnel. The operator also serves as a central link in the intercommunication network connecting all drive locations, ride service areas, and ride guard stations.

Ride Passenger Seats

The 463 three-passenger fiber glass seats, designed by the Styling Staff, are spaced at four-ft intervals on the ride. Each seat has three separated high backs in which the sides of the head rests are formed inward enclosing individual speakers for the ride sound system (Fig. 7). Passenger seating areas are separated by a slight ridge effect for individual comfort. Arm rests are provided at the sides of the seat.

Each seat, set on a 3/4-in. thick carpeted platform, is bolted through

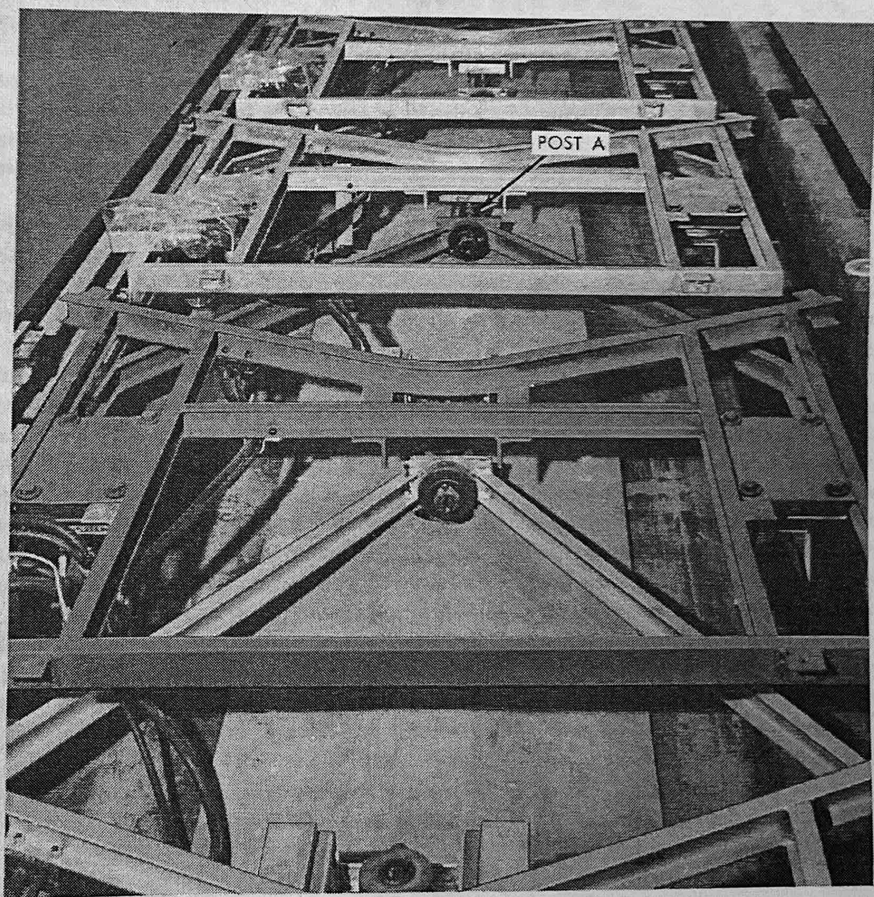
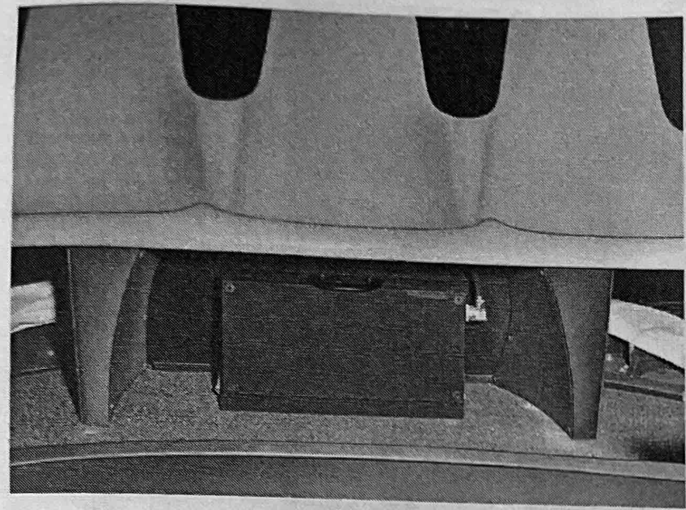


Fig. 8—The vertical post extending upward from each master carrier serves a dual purpose as shown in this photograph of seat chassis installed on the track. Each post pulls one chassis while guiding the chassis ahead, as shown by post *A* which pulls the chassis shown in color and guides the one ahead. This photograph shows a temporary cardboard dust cover placed over the track center opening to protect the driveline and drive units during installation.



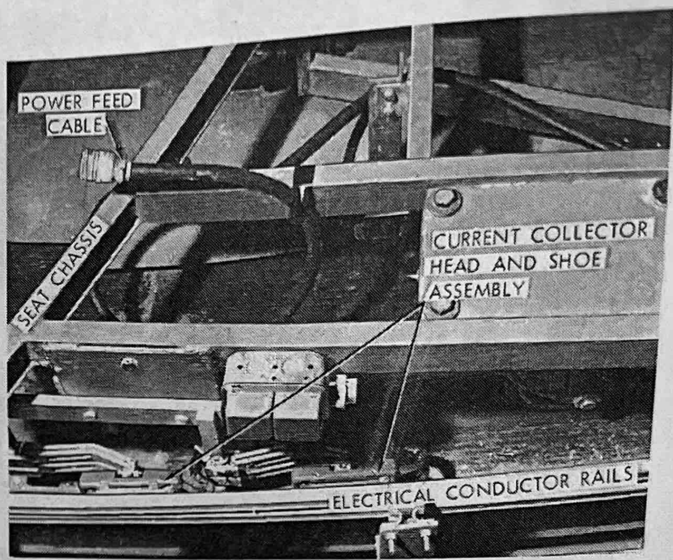


Fig. 9—Sound reproducing units (left) are located under every third seat. Power for these units is picked up through a double brush collector (right) at every sixtieth seat. The collector rides in an electrical feed rail attached to the side of the track. The rail runs the entire length of the track.

rubber bushings to the steel chassis. The front and rear edges of the platform are concave and convex, respectively, to maintain a constantly closed fit during turns. A fiber glass toe board at the front of the platform serves both as a foot rest and as a cover projecting over the narrow opening between platforms.

The chassis is a welded steel channel frame riding on two plastic tired, castered wheels. Two steel side members of the chassis frame extend and converge forward of a rectangular base to form a slightly downward sloping triangular connecting point. Attached to the apex of this triangle is a rubber mounted spherical bearing that connects to the vertical post of the master carrier and is contained by a pair of retainer collars on the post. This front connection is used to pull the chassis. Lateral guidance for the chassis is provided by two thicknesses of 1/2-in. rubber belting, slotted longitudinally, and attached to the chassis with the center of the slot at 48-in. behind, and slightly above, the front connection. Thus, each vertical post of the driveline master carrier, having a nominal pitch of four ft, is used to pull one chassis and guide the one ahead (Fig. 8).

Ride Sound System

Each head rest has two loudspeakers through which each passenger listens to a synchronized narration of the show scene being viewed (Fig. 7). The description of the show is reproduced on a specially developed unit for repetitive reproduction of sound, pre-recorded optically on a film base. The reproduced sound is binaural voice with sterophonic musical background. The sound is recorded on four tracks, two for forward and two for reverse playback. The film transport, with a 15-minute capacity playing time in either direction, runs at a speed of 7.2 in. per second. A starting switch bar on the track starts the sound reproducing unit for every ride circuit. Completing the ride circuit, the sound film stops midway between the unloading and loading areas, automatically reverses itself, and is started again by the starting switch bar.

An integral transistorized amplifier produces high fidelity sound, and its binaural effect directs the attention of the listener to the particular scenes on either side of the ride as he passes through them.

One sound reproducing unit is used for every three seats, providing narration for nine passengers. Each unit is powered by 110-v a-c picked up through a double-brush collector located at every sixtieth seat. The collector rides in an electrical feed rail attached to the side of the ride track. The sound reproducing units are located under the seats. The wiring harness is concealed within the legs of the seat and under the seat platform (Fig. 9).

Moving Belt Walkways

Two moving belts are provided—one for loading passengers onto the constantly moving Futurama ride and one for unloading them (Fig. 10). Each belt is 66-in. wide, with an exposed width of approximately 60 in. The belts have longitudinal grooves 3/16-in. wide and 1/4-in. deep with tapered sides. Floating comb plates, located at entry and exit ends, mesh their fingers into the grooves of the belt.

The loading and unloading belts are 69 ft—9-3/4 in. and 61 ft—3-3/4 in. long from comb plate to comb plate, respectively. Each belt unit includes a single closed balustrade located on the right side in the direction of belt travel. The speed of these units is synchronized with the speed of the ride, and the edge of the ride seat platform slightly overlaps the moving belt. Passengers take their seats with no perceptible awareness that they are stepping from one moving surface onto another.

Elaborate safety precautions make it impossible for any jamming to occur at the floating combs. Should anyone decide not to board the ride, he may simply proceed to the discharge end of the moving belt and step off. At the unloading area, passengers leave their seats and are carried by the belt towards the exit.

Passenger Safety Provisions

The foremost consideration in the design of the ride was to provide maximum passenger safety. One of the unique features of the ride is that the seat carrying chassis will not leave the track if driveline separation should occur for any unforseen reason. Driveline components were subjected to exhaustive endurance and reliability tests and were designed to exceed the maximum recommended factor of safety.

The service walkway along the entire length of the ride connects to an adequate

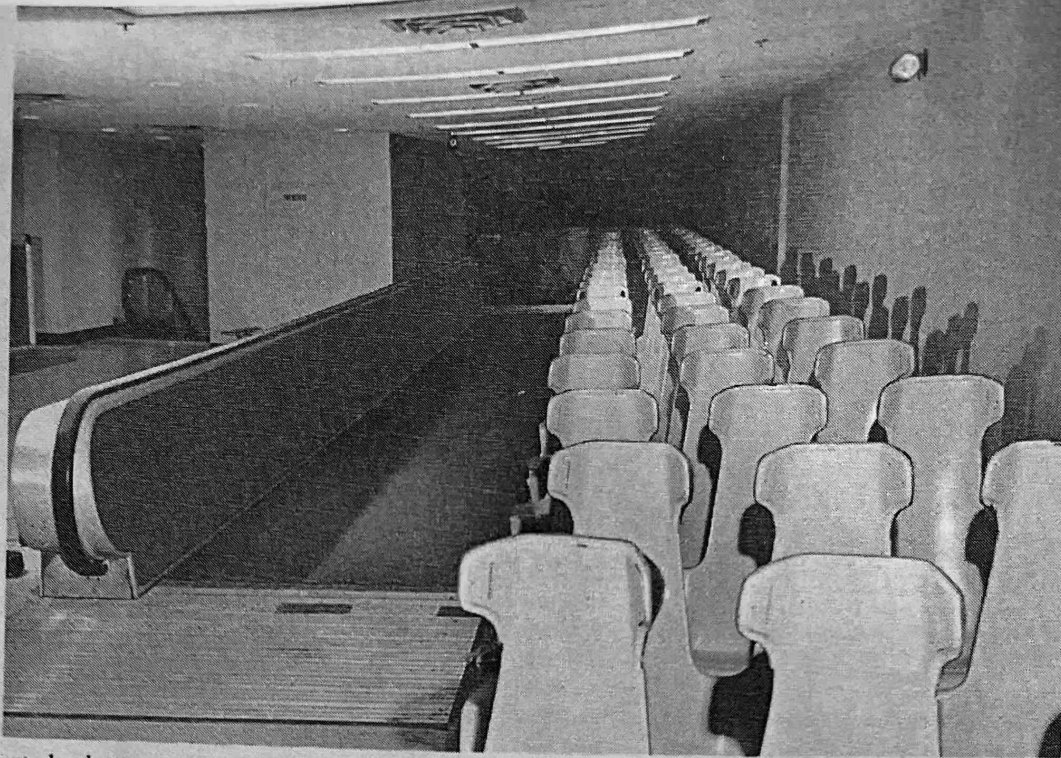


Fig. 10 — Loading and unloading of passengers is accomplished by two moving belt walkways running parallel to the track and moving at the same speed as the ride. One of the walkways is shown here.

number of passageways that lead to building exits for egress of passengers in case of an emergency. During such a time, the ride would stop and a system of overhead and foot lighting would automatically and instantaneously be switched on. Guards are posted strategically along the ride to aid passengers in the event of an emergency. Automatic sprinklers and smoke detectors are installed throughout the exhibit area for fire protection. A complete intercom and public address system provides full communication at all times.

Prototype Ride Constructed

Since the idea for the ride mechanism was an entirely new and untried concept, Styling Staff tested it thoroughly. To do this, a prototype test track loop 308 ft long was built and installed in a building near the GM Technical Center. The test track contained two straight sections, with an elevation differential of 10 ft, which were joined together by two semicircular spiralling sections of 32 ft radius. The incline and decline angles for the track along the spirals were selected at 10°-0′ and 5°-41′, respectively. This was done to study the effect on passenger comfort while negotiating these slopes.

The test track operated under maximum load conditions for nearly 500 hours, and was used effectively to:

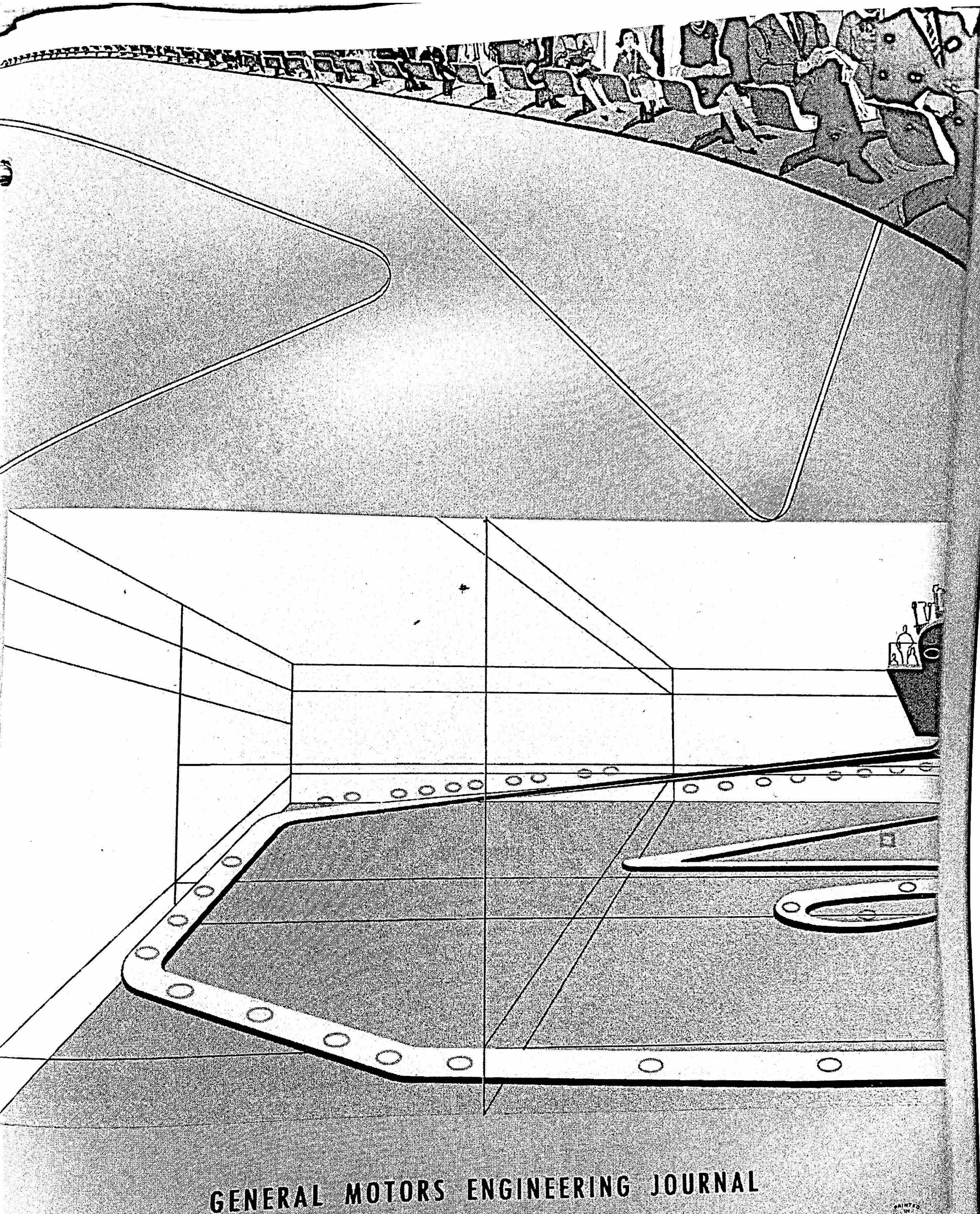
- Test the Futurama ride conveyance system in all its aspects, including mechanical, electrical, and—for smoothness—quietness and reliability of operation
- Try out various configurations of passenger seats and seating arrangements
- Determine the best possible sound system for the ride, the best means of reproducing it, either through loudspeakers built into the seat or hand held, and a method of eliminating sound interference between adjoining seats
- Test viewing reaction to a number of scenery sets that were erected around the track and to establish the optimum ride speed for maximum perception and enjoyment of scenery.

In checking the mechanical operation of the test ride, the Test Department of the GM Engineering Staff was asked to test certain operating characteristics of the system. These included measurements of the tension loading in the driveline under various conveyor loads and drive conditions as well as bending stresses in the swivel type couplings connecting the driveline components. The results of these tests were effectively used in perfecting the final drive assembly and driveline design.

As a further step in assuring a reliable ride operation which would run 12 hours per day, seven days per week, and six continuous months per each of the two operating seasons, the Vehicle Development Group at the GM Engineering Staff was requested to design and build a test fixture to conduct a test program of driveline components and determine their adequacy and durability. These tests resulted in modifications of the final design and parts fabrication.

Conclusion

The advance preparations for the Futurama II ride were proven successful when the ride was installed, ahead of schedule, in the GM Pavilion at the World's Fair site. The results of the preliminary full load tests indicated that the original design objectives had been met and that the ride stood ready to transport visitors on an exciting journey into the future.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