Sound Reinforcement at Expo 67

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World's Fairs have become a showcase for new developments in sound systems. Expo 67, which closed this past October, saw many innovations. Our man-at-the-Fair looks at the most interesting structures and systems.

SEVEN years ago, when bids for the next *official* World's Fair were being considered by the Bureau of International Exhibitions, the nod went to Russia and the Soviets started to make plans to hold a "first category" exhibit. Two years later, however, they withdrew and Canada, the other country under consideration, won the honor. Coincidentally, the year chosen for this huge display, 1967, was also an anniversary year for Canada. Nothing could stop this show from being the biggest fair ever.

As more and more nations, states, provinces, private exhibitors, world organizations, and municipalities signed up for space it became apparent that existing techniques were not good enough and that displays had to be larger, more complex, and novel in order to stand out among the competition. The fact that Montreal, rather than Moscow, became the site for Expo 67 gave the chance to many of us to feast our eyes and ears on the presentations to be offered by the *first* sanctioned World's Fair on North America.

Some of the structures were purely functional and were designed to perform as lecture halls, movie theaters, arenas or combinations of these applications. Others were specifically made to house a variety of shows including live talent in different fields of show business. A great number, however, were built to provide a setting for some startlingly new audio-visual displays, the likes of which had not been seen or heard before.

Among the multi-function auditoria included were the **Expo Theater, Theater Port-Royal,** the **Salle Wilfrid-Pelletier,** the **Theater Maisonneuve** and the **duPont Auditorium.** Each of these required a specially designed sound distribution system and a thorough study of acoustic requirements to provide the best listening possible everywhere in the hall.

An illustration of some of the functions and uses of these theaters and their relative sizes will present an idea of the required sound distribution treatment. **Expo Theater** was built in the shape of a wedge to seat 2,000 people. Its uses were for popular entertainment, musical shows by a variety of performers from many foreign countries and it was also the site of the **International and Canadian Film Festivals.** The theater was designed without a center aisle, continental style, with provision for 1,300 seats in the orchestra and 700 in the balcony. The upper level of seats did have a center aisle. The stage was 120 feet wall-to-wall, 45 feet deep, had a proscenium opening 28 feet high and 50 feet wide and a grid elevation of 77 feet. The pit was large enough for an orchestra of 60 musicians. Equipment was provided for a variety of sound reproduction and projection functions.

Some of the performances given at this theater were the *Swiss Folkloric Gala, Hello Dolly,* the musical comedy *Half a Sixpence,* Marlene Dietrich, the Lehar operetta *The Land of Smiles,* Jack Benny, many country-and-western performers, Duke Ellington and Pearl Bailey, and the finale of the International Poetry Gala. In addition, the theater was used for *The 8th Montreal International Film Festival, The Fifth Festival of Canadian Films* and *A World Retrospective of the Animated Cinema.*

For a quick comparison, the **Wilfrid-Pelletier Theater** had 3,000 seats on four levels from orchestra to the third balcony with the farthest seat 140 feet at the highest point and 112 feet at the orchestra level. The stage was 55 feet deep, 100 feet wide and the grid was 80 feet high. The orchestra pit could hold 100 musicians.

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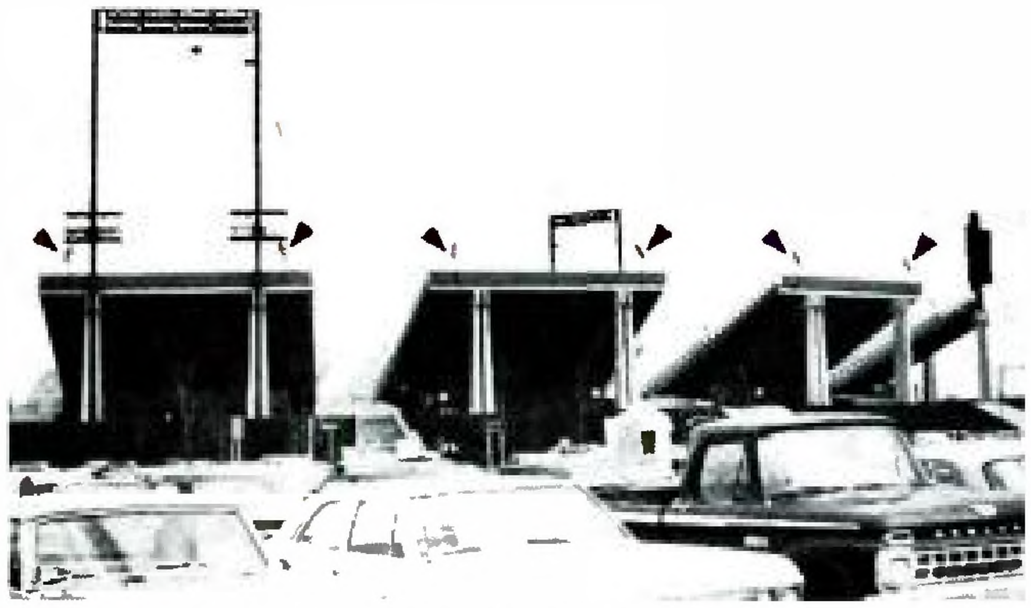


Fig. 1. Autostade Stadium — the arrows show the location of some of the 38 sound columns used for distribution.

Fig. 2. A view of the Kaleidoscope pavilion (and the crowds that waited to visit it).

The other two theaters were smaller. The **Port-Royal** held 800 while the Maisonneuve could seat **1,300.** The former had a proscenium height of 80 feet which could be scaled down to 40 feet. The proscenium of the latter was 60 feet high.

The **duPont Theater,** with 372 seats, was built for lectures, films and small group performances such as poetry readings. For the 800 scientific films scheduled to be presented and the many lectures and meetings held here, the specifications called for two 35mm sound projectors, two large RCA theater units mounted high at a calculated angle and orientation, a modified 100 watt amplifier, two equalizers with provisions for bass cut and 6 dB boost in the 3,000 to 8,000 Hz range for voice intelligibility, a four-channel mixing console and an assortment of directional, cardioid and lavalier microphones.

The largest outdoor arena, called the **Autostade,** was built to hold 25,000 spectators of sports events and spectaculars. Among the shows given at this amphitheater were *The Ringling Bros.-Barnum and Bailey Circus* (staged for the first time in the open); *The Canadian Air Force Tattoo*; a musical extravaganza starring Maurice Chevalier, with 700 men, many horses, motorcycles and jeeps; and the *Wild Horse Spectacular, and Great Western Rodeo.*

The oval-shaped amphitheater was formed by 19 precast seating sectors. The slope upward of the seats created the shape of a bowl. The seats could be dismantled and reassembled elsewhere or enlarged to contain 40,000 seats. The turf was 535 feet long by 212 feet wide. This was surrounded by a six-lane rubberized asphalt running track a quarter mile in length.

For sound distribution, 2 sound columns were located at the rear of the audience, one on each side of each seating sector (see FIGURE 1). Each of the 38 columns contained 6 Altec 403's. Six more columns containing Altec 755C speakers were used to cover the field. As no directionality of originating sound was required the prime consideration for location of the speakers was mass coverage. Fortunately, there was little outside interference from traffic or airplanes.

Amplification was achieved by using ten 175-watt amplifiers paired by Altec Sequr units to prevent loss of feed or level in the event one of the amplifiers became defective. Mixing was done with two Altec 1567's in the control room and two more portable units. Constant level control was maintained by compressors.

In addition, a performer paging system, a rehearsal paging unit and a management monitoring system were also provided with horns and 60 watt amplifiers.

An interesting but disturbing acoustic effect was created during those shows requiring the laying of a hard floor or paving of the ground. Sound from one side of the arena would bounce off the hard surface and create an echo on the other side of the bowl. The number of times such a situation existed, fortunately, were few.

Kaleidoscope

Among the private exhibits designed for effect, both inside and out, was **Kaleidoscope**. The structure was conceived by 6 Canadian chemical corporations to present *Man and Color*. The exterior of the circular building was made up of 20-foot high fins (FIGURE 2) colored on both sides to conform to the color spectrum and thus creating an illusion of movement of the building as the visitor walked by. Inside, the building was shaped like a cross with four chambers around a central core. One of the chambers was used for loading and unloading the visitors to the pavilion. The other three were presentation theaters.

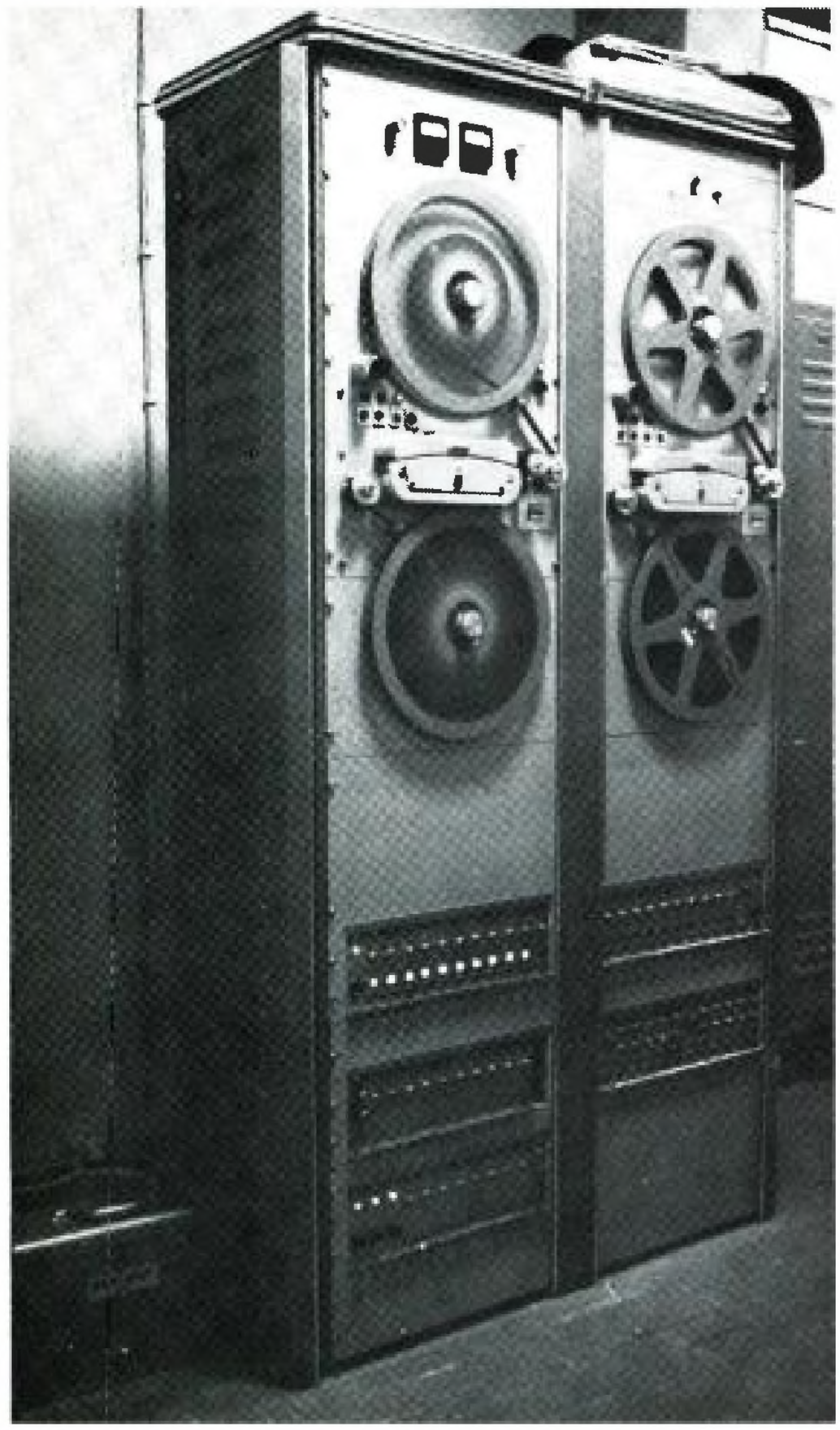
With the use of mirrors to reflect many times a single image on an 8- by 10-foot screen, the viewer was surrounded by color patterns and lights. He was actually inside the kaleidoscope.The films shown were taken of real objects as well as surrealistic patterns. Multi-reflections of these images created an all-around sensation. The program depicted a typical day.

The audience entered a completely dark room. The sky is starlit as the sun starts to rise. The horizon seemed infinite. As the morning effect progressed, the colors and patterns changed accordingly. The second chamber illustrated the middle of the day. Colors and images were more vivid and changes were more violent and drastic. The third room depicted the return of evening. Colors changed to a more peaceful mood. As the chamber darkened, the stars reappeared.

Throughout the performance, sound, both natural and electronic, as well as traditional music heightened the various effects. The audio, dubbed onto the sound track of the 35mm film, was distributed through three speakers at the back of each of the rooms. As source location was not important, those rear speakers proved sufficiently effective.

Fig. 3. The Canadian Katimavik exhibition building. A 190-seat revolving theater was inside this inverted pyramid.

Fig. 4. The two Philips ten-track tape units used at the Czech Diavision display in their pavilion. Each of the ten tracks had a different control function for the display.



In most exhibits such as this one just described, where the audience is moved between chambers, great care is taken to prevent leak-through from one auditorium to the other. In this exhibit, leak-through was actually *provided* between chambers by feeding sound from one chamber into the speakers of the adjacent one. The purpose for the mixed feed of sound between rooms was to maintain an over-all perspective for the listeners as they went through the different presentations. As the audio consisted of sound and music only, there was no problem with intelligibility.

Katimavik

One pavilion in which there was evidently some difficulty in preventing leak-through was at the Canadian **Katimavik**. The structure, an inverted pyramid (FIGURE 3), contained many displays showing life in Canada. One of the feature demonstrations was in a 190-seat revolving theater.

The five-theater turntable rotated through a similar number of 4½-minute shows in which the 950 spectators were told the story of Canada. The first film was on a single screen. No sound problem. The second contained two screens, one vertical and the other horizontal. Here, the sound was still front projection and there were no problems. The coverage was adequate and the program material did not require any great variations in levels.

The third theater presented an amusing animated cartoon on three screens. The presentation depicted musically the mixing of cultures ranging from *Rule Britannia* through *Alouette* to American music and then to an ethnic folk festival. The action was much more lively to enhance the comedy effect. the sounds were louder and the mixing of one selection on top of another required an over-all higher level of sound. Also, speakers in the ceiling over the audience were used to add to the montage.

The fourth chamber exhibited the industrial expansion of Canada on a single screen and the audio consisted of lowered levels of music. The fifth theatre showed the people of Canada and jazz was mixed with modern sounds as musical accompaniment. The relative levels of the last three chambers caused slight leak-through into the quiet ones.

Man in the Polar Regions

Another exhibit in which the audience sat on a rotating turntable was **Man In the Polar Regions.** This presentation varied from the previous one in that this turntable rotated continually during the performance while the other stopped in each segment.

The rotating platform, 80 feet in diameter, made its complete round in just over 20 minutes. The turntable was divided into four pie-sections around a stationary core containing all the projectors, synchronizing equipment, power units and sound amplification equipment. The movement of the theater was slow enough to permit the audience to enter and leave the first theater, at one point in the circumference, without realizing the turntable was still moving.

Around the perimeter of the theater were twelve screens. A similar number of projectors, each with a sound-on-film continuous loop of the same length, was started by a microswitch activated as the partition between theater segments passed by. Each length of projection film and black leader was accurately timed to permit the machines to stop when the projection time was over. Each was then started again at the proper time to continue the cycle. Images could be shown on one, two or three screens at a time within any chamber.

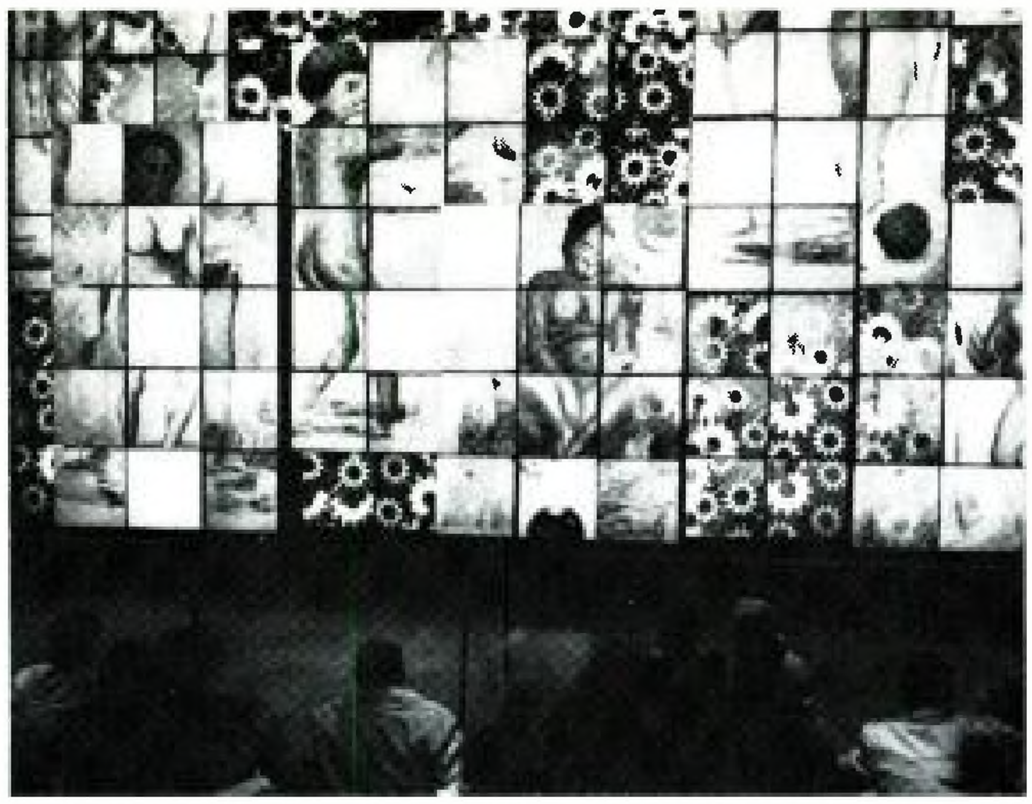


Fig. 5. A view of the Diapolyecran screen during the presentation at the Czech pavilion. Each square represents a separate projection.

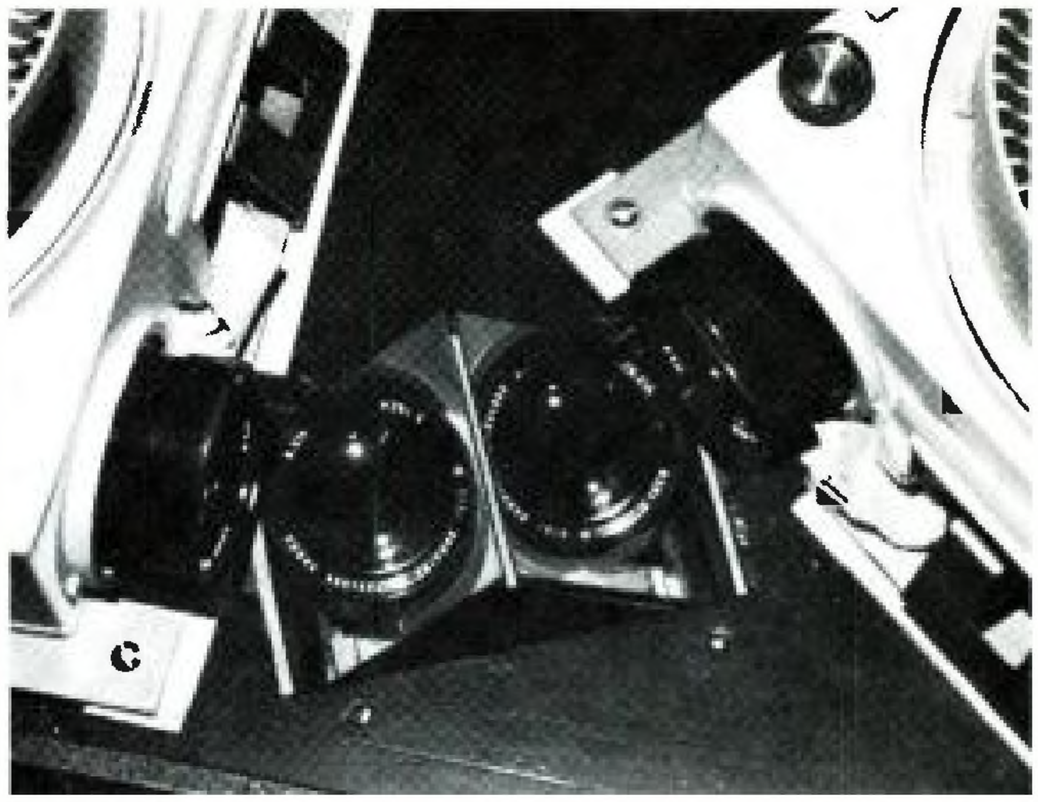


Fig. 6. Two of the six Carousel projectors used for rear-screen projection at the Kodak pavilion. Each pair operated as a single unit, dissolving to the other for smooth transitions.

By recording sound on any one or more of the films available to each segment at any one time, the sound followed the movement of the projected images around the loop in synchronization with the audience. A speaker was located under each screen.

Each theater was enclosed on the left and right sides by high walls. Adjacent walls were separated by a passageway for entry and exit from the core. This large air gap decreased greatly the possibility of sound from one chamber leaking through to the next.

The Canadian Pulp And Paper Association

This exhibit presented another interesting use of sound in a circular theater. In the first of two theaters, the audience stood in the center of the room around which the wall undulated in the manner of a sine wave. This wall was the projection surface for six slide machines and a 16mm film projector located in circular housings suspended from the center of the ceiling. The upper housing was stationary and contained the slide projectors. The lower one was movable and could rotate through almost 360°. This one housed the film unit.

The presentation, depicting the history and uses of paper, combined slides, film and live actors. The performers worked on a 2½-foot wide ramp built in front of the wall and made to rise and fall in line with the bottom of the projected images. As the performers were required to move around the room to coordinate with the characters in the pictures, microphones were located at selected points either mounted on floor stands or hung against the screen wall. Movement had to be quick, precise and accurately timed as the actors were required during the show to reach out to the screen, take an object from the character in the picture and then return it to the proper point on the screen so that the effect of this illusion was not lost.

An 82-channel programmer controlled the movement of the 16mm housing, the lights, the action of the slide projectors, and the opening and closing of microphones and speakers as the show moved around. Recorded sound was distributed by speakers in the wall while live sound covered the audience from carefully located sound columns. The microphones were a close-talking lavalier type to help avoid the possibility of feedback.

Czechoslovakia

By far, one of the most ambitious audio-visual undertakings at the Fair was the presentation at the Czechoslovakian pavilion. Soft classical music, distributed by well-spaced ceiling-mounted speakers followed the visitor during his tour of the main floor to see glass work made in that country. On the upper level, two panoramas of multi-screen projection and surround sound awaited the people.

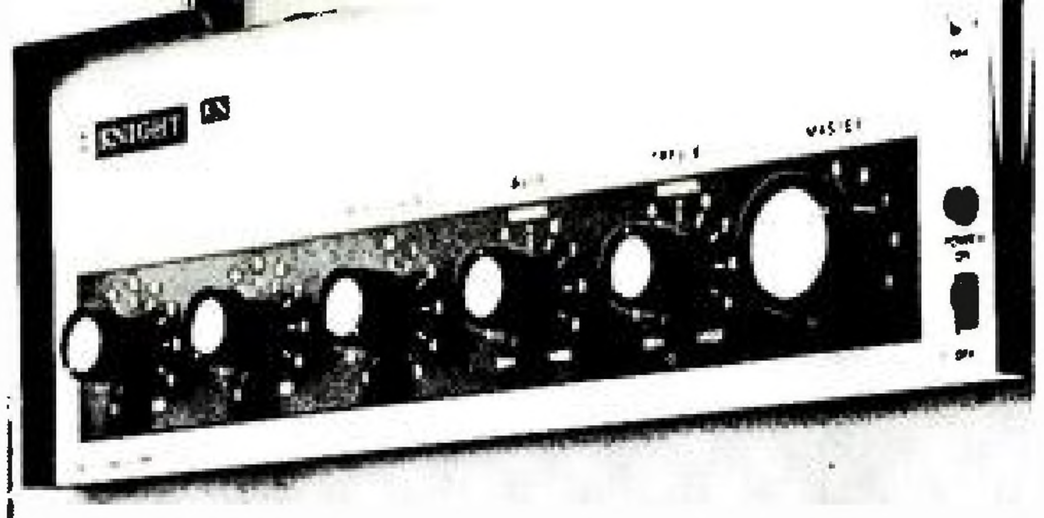
The first chamber consisted of several displays of novel projection techniques. One was called *Polyvision* and comprised twenty slide projections, eight movie screens, two rear-projection displays and several rapidly rotating bodies shaped like a sphere or hyperboloid and made of thin metallic strips. Between the rear projection screens, located toward the back of the stage area, and the front multi-screens there were two semi-transparent mirrors placed at angles of 45° to the horizontal. With slide projectors mounted inside movable cubes and projecting on static or rotating surfaces, rear projection and reflections of projections seemingly suspended in mid-air, the eight-minute display was indeed a novelty.

Another presentation, called *Diavision*, consisted of a specially treated screen which appeared to be a large picture print. With the proper change in lighting the picture seemed to disappear and the audience could look through the mesh to a multitude of projection screens. Another part of the display consisted of three layers of stretched nylon thread in the general shape of a loom. The entire frame was set into swinging motion while the third layer was set into oscillation about its axis of symmetry. All of the 160 cords then acted as a screen for the projection of 35mm images making them appear to be three-dimensional.

Throughout this entire performance, surround music and sound effects were distributed from speakers located all around and above the audience. A Philips ten-track tape machine controlled the entire exhibit. One track was used for music and sound, another for controlling groups of loudspeakers, three for feeding signals to decoders and relays for triggering a myriad of control film and light circuits and the last five tracks to feed as many decoders for the control of 36 projectors each. Two such control machines (FIGURE 4) were used to provide continuous showing.

The second auditorium offered an eleven-minute show

Fig. 7. This behind-the-scenes view at Kodak shows the set-up used for the water screen projection. The hydraulic system used to create the water screen extends from the right to the center. The black boxes in the foreground each contain a pair of projectors as seen in Fig. 6. Each is covered, but a cutout allows the image to be reflected by mirrors onto the wall mounted mirrors (upper left), then to the water screen.



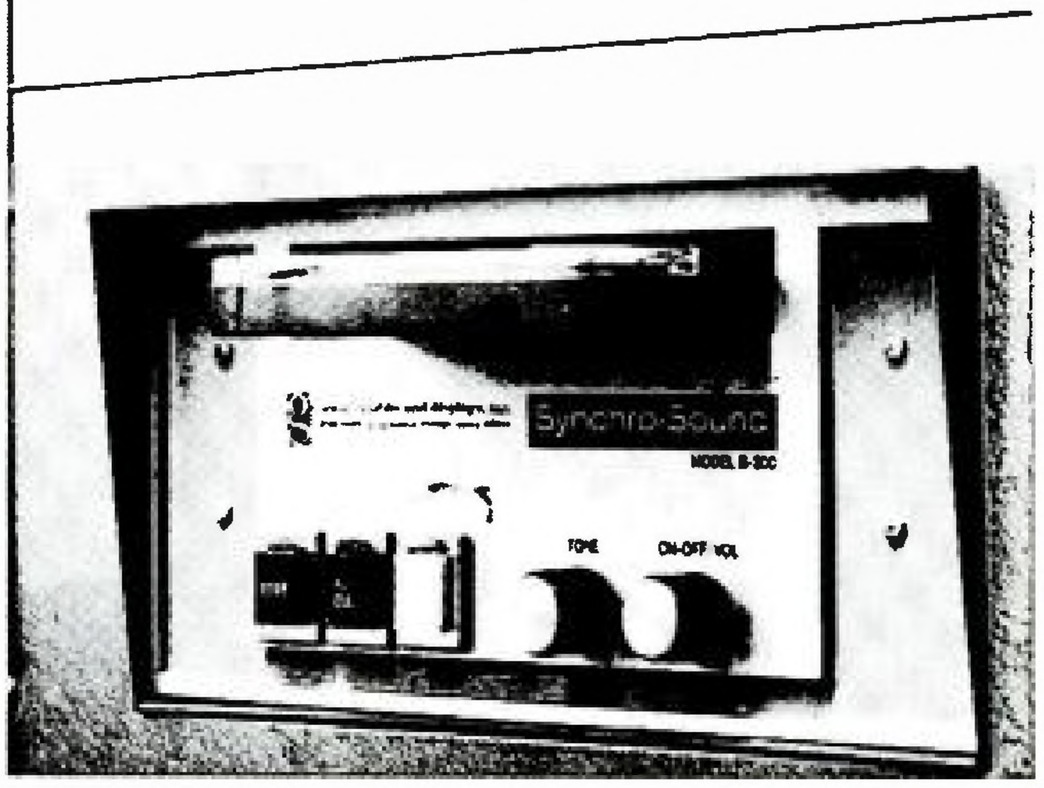


Fig. 8. This amplifier, a Knight KN3235C, and the tape loop player, a Synchro-Sound B-300, controlled the Kodak exhibit. The tape carried a sound channel while also providing a second channel pulse which controlled a punched belt. This belt (not shown) activated the show system's components.

called *Diapolyecran*. This presentation took place on a 32-foot by 20-foot wall divided into eight horizontal rows of fourteen cubes, each cube being two feet on a side. Each cube contained two slide projectors modified with an electromagnetic diaphragm permitting picture changes of less than 0.05 seconds. Each projector had 80 slides. Each cube could be moved horizontally to one of three positions with a total move of 24 inches. Thus, the wall could form a solid picture, a picture with some images forward of the wall or to the rear, or any desired combination.

The control system consisted of a 35mm film with each frame divided into a checkerboard pattern of 840 squares. Show control made use of 784 of the spaces while the remainder were used for system measurement. By programming black and white spaces as required and then shining light through them onto a similar mosaic of photo-resistors, slide changes and cube movement could be accurately synchronized for proper system operation and an extraordinarily effective display. This exhibit used 224 slide projectors, over 12,000 slides, nearly 20,000 electrical impulses available every second and over 5 million bits of control information. Specially written music along with sound accompanied this elaborate demonstration. The Czechs proved they had progressed in the field of audio-visuals since they won gold honors at the 1958 Brussels Fair.

It is interesting to note in passing that the French pavilion also made use of a patterned 35mm film for control. In this exhibit, a magnetic sound track of electronic music, created by using many oscillators to produce true tones, harmonics, and different wave forms, was piped to speakers while the control information was utilized to trigger lights in time with the music. Colors, brightness, and sudden flashes created a startling visual display synchronized with the variations in the musical score.

Kodak

An interesting exhibit in which a multi-track tape was used for sound and control signals was Kodak, one of the few exhibitors participating in every World's Fair since 1893. Six Carousel slide projectors (FIGURE 6) were used for the first five minutes of the presentation to display pictures on a conventional screen. The last three minutes were used to project three pairs of slide units, through prisms and mirrors, onto a rear-projection screen made of *water*.

The 3,000 tiny vertical jets of water, streaming from above and below, were produced by a hydraulic system controlled by a punched paper tape triggered by the cues on the sound tape. Changes of slides (1½-second lap-dissolve or instantaneous) as well as variation of jet pressure and direction flow were all controlled by the tape. The display consisted of city skylines shimmering, fishes swimming (a natural), fireworks exploding, butterflies floating and go-go girls go-going. Sound on the first of the two magnetic tracks was distributed through speakers mounted above the screens (out of the way of the water).

A World's Fair of this magnitude had to prove that it was the biggest and best ever. It did. It also proved the importance of sound and the proper design and engineering of the distribution systems. It showed the value of the services of a competent audio-visual engineer in endeavors of this nature. Expo 67 also disproved the belief that there is nothing new under the sun. Let's see and hear what the next Big Show of 1970, in the Land of the Rising Sun, will have to offer.

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