= Leslie speaker =

The Leslie speaker is a combined amplifier and two @-@ way loudspeaker that projects the signal from an electric or electronic instrument , while modifying the sound by rotating the loudspeakers . It is most commonly associated with the Hammond organ , though it was later used for the guitar and other instruments . A typical Leslie speaker contains an amplifier , and a treble and bass speaker ? though specific components depend upon the model . A musician controls the Leslie speaker by either an external switch or pedal that alternates between a slow and fast speed setting , known as " chorale " and " tremolo " .

The speaker is named after its inventor , Donald Leslie . Leslie began working in the late 1930s to get a speaker for a Hammond organ that had a closer emulation of a pipe or theatre organ , and discovered that rotating sound gave the best effect . Hammond was not interested in marketing or selling the speakers , so Leslie sold them himself as an add @-@ on , targeting other organs as well as Hammond . Leslie made the first speaker in 1941 . The sound of the organ being played through his speakers received national radio exposure across the US , and it became a commercial and critical success . It soon became an essential tool for most jazz organists . In 1965 , Leslie sold his business to CBS who , in 1980 , sold it to Hammond . Today , Suzuki Musical Instrument Corporation owns the Hammond and Leslie brands .

Because the Leslie is a sound modification device in its own right , various attempts have been made to emulate the effect using electronics . Many musicians have used the Univox Uni @-@ Vibe , the Neo Ventilator , or Hammond @-@ Suzuki 's own simulator in a box .

= = History = =

Leslie worked as a radio service engineer at Barker Brothers Department Store in Los Angeles , which sold and repaired Hammond organs . He bought one in 1937 , hoping it would be a suitable substitute for a pipe organ . He was disappointed , however , with the sound in his home compared to the large showroom where he originally heard it . Consequently , he attempted to design a speaker to overcome this . He initially tried making a cabinet similar to Hammond 's , but soon concluded that pipe organs produced a spacially varied sound because of the different location of each pipe . He set out to emulate this by making a moving speaker . He tried various combinations of speakers and speeds , and discovered that a single one running at what 's now known as the " tremolo " speed worked best . After further experimentation , he decided that splitting the signal into a rotating drum and horn helped accentuate bass and treble frequencies .

By 1940 , Leslie decided his prototype was ready to market , and went to the Hammond Organ Company to demonstrate it . Laurens Hammond , however , was not impressed with Leslie 's attempt to better his own organ design , and declined to market it . The company even changed the speaker interface on their organs to make them " Leslie @-@ proof , " though Leslie quickly worked around this . Leslie began manufacturing the speaker in 1941 ? initially under a variety of names , including Vibratone , Brittain Speakers , Hollywood Speakers , and Crawford Speakers . He returned to the name " Leslie Vibratone " in 1947 . To counteract Hammond 's slogan " Music 's Most Glorious Voice , " Leslie added a similar slogan , " Pipe Voice of the Electric Organ " to the plates . He eventually owned nearly 50 patents on the speaker .

Leslie manufactured the speaker to work with other organs besides Hammond , including Wurlitzer , Conn , Thomas and Baldwin . He never particularly liked Hammond organs , once remarking " I hate those damn things . "

In 1965 , Leslie sold the company to CBS , which had also acquired the Fender guitar company . In 1980 , the Hammond Corporation finally bought Electro Music and the Leslie name from CBS . After Hammond went out of business in 1986 , a former engineer re @-@ established Electro Music , licensing the name from Noel Crabbe , who had acquired the rights to Hammond . It was subsequently sold to Suzuki in 1992 , who continue to manufacture the speaker .

= = Features = =

A Leslie speaker consists of a number of individual components . The audio signal enters the amplifier from the instrument . Once amplified , the signal travels to an audio crossover , which splits it into separate frequency bands that can be individually routed to each loudspeaker . Different models have different combinations of speakers , but the most common model , the 122 , consists of a single woofer for bass and a single compression driver and acoustic horn for treble . The audio emitted by the speakers is isolated inside an enclosure , aside from a number of outlets that lead towards either a rotating horn or drum . An electric motor rotates both horn and drum at a constant speed .

The only control common to all Leslie speakers is a dial that controls the master volume . This is normally set up once and then left , since the organ 's expression pedal normally controls the volume . Leslie recommended playing the organ at full volume with all stops (drawbars) pulled out and adjusting the volume just before distortion occurs . However , the distorted sound of an overdriven vacuum tube amplifier can be a desirable sound , to the extent that modern Leslie simulators have an explicit " overdrive " setting .

Control of a Leslie speaker is normally catered for by an external two way switch , between two settings marked " chorale " and " tremolo " . The switch is mounted onto the controlling instrument , so the player can easily switch settings . Some earlier models were limited to " off " and " tremolo " , and some later models had all three settings . The switch can be used while notes are being played , and the sound of changing between the two settings is part of the characteristic sound . On both settings , the treble horn rotates slightly faster than the bass woofer ; about 50 revolutions per minute (rpm) for " chorale " and 400 rpm for " tremolo " , compared to the woofer 's 40 rpm and 340 rpm respectively .

Unlike most popular music amplifiers , that use jack plugs to connect to instruments , Leslie speakers use an amphenol connector to interface directly to an organ via a console connector . The type and design of the connector depends on the organ and model of Leslie speaker .

Older models that used tube power amplifiers used a variety of 6 @-@ pin connectors , while later models used a 9 @-@ pin connector . In all cases , for a single organ ? Leslie configuration , the mains power , audio and control signals are all carried on the connector , and the design of the pin layouts varies between organs and speakers . Care must be taken when attempting to service them since an incorrectly or poorly wired cable can cause permanent damage to the organ and / or speaker , or result in electrocution . It is also possible to connect multiple Leslie speakers to a single organ , by using a power relay that provides the necessary AC current .

A separate device known as the combo preamp is necessary to connect a vintage Leslie to another instrument such as a guitar . This combines a separate AC input and line level input onto a single amphenol connector , and provide a footswitch to select between the speeds of the Leslie . Modern products such as the Trek II UC @-@ 1A allow any instrument with a phone jack connection to use a variety of Leslie speakers .

Modern Leslie speakers have an 11 @-@ pin interface that is safer to service , as the mains power is carried separately using a standard IEC mains connector . The Hammond @-@ Suzuki Leslie 2101 also includes line in and line out jacks , so a combo preamp is no longer required . Its settings can also be controlled via MIDI .

= = Models = =

= = = Single speed = = =

The initial models of Leslie speakers did not have the " chorale " setting . The control switch was simply a choice between " off " and " tremolo " . The first model of Leslie produced was the 30A . It emulated Hammond 's DXR @-@ 20 tone cabinet , which used moving drums but only produced amplitude modulation , not frequency modulation . It contained a 15 @-@ inch (380 mm) drum and the power amplifier was housed in the top of the unit , to allow easy repair . This was superseded

between 1947 and 1949 by the 31H , also known as the " Tall Boy " . It was similar in appearance to the 30A , but contained additional louvres along the top of the cabinet . Also , reflectors were placed on the end of the horn , to allow the treble signal to exit the unit through the sides , rather than on the top .

The next models Leslie produced were the 21H and the 22H , which had a cabinet in a similar styling to the better known 122 , with the same dimensions and louvres . They were powered by a 40 watt tube amplifier .

= = = Dual speed = = =

The 122 is the most popular Leslie . It was specifically designed for the Hammond organ and is the model most commonly identified with it . It is 41 inches (1 @,@ 000 mm) high , contains separate motors for chorale and tremolo , and a 40 watt tube amplifier . The 122 is the most adaptable to being recorded , as it has a balanced signal which eliminates mains hum and other noise . The 122RV was the same model , but with an additional reverb amplifier , which fed through to a separate static speaker . A slightly smaller version , the 33 @-@ inch (840 mm) 142 was available . Hammond @-@ Suzuki currently manufacture the 122A , a straight reissue of the 122 , and the 122XB , which contains a modern 11 @-@ pin adapter , an IECC mains adaptor , line @-@ in , and a jack socket for a footswitch to control the speed . This eliminates the need for a combo preamp .

The 147 is the " universal " version of the 122 , designed for many organs , and has a different amplifier input and motor speed control , but is otherwise identical . The signal input is unbalanced , allowing a simpler connection to organs that have a built @-@ in speaker system , such as the Hammond A100 , or a Wurlitzer . The motor speed switching uses a separate AC signal , rather than the DC voltage control of the 122 . In operation , the noticeable differences between the 122 and the 147 are the 122 's lower susceptibility to induced noise , and a delay between operation of the speed control and the actual change in speed . As with the 122 and 142 , the 145 is identical to the 147 , except that it is housed in a 33 @-@ inch (840 mm) cabinet , and thus slightly easier to move . As with the 122 , Hammond @-@ Suzuki manufactures a modern replacement , the 147A .

The model X @-@ 77 , released in 1968 , was designed to accompany Hammond 's new tonewheel / transistor organ , the X @-@ 66 . It contained seven different tab controls and six speakers . It has a completely different interface from other Leslies , using a 12 @-@ pin amphenol connector .

= = = Pro @-@ Line = = =

By the late 1960s , gigging musicians were finding that older Leslies like the 122 were not loud enough for large venues , which led to the introduction of the " Pro Line " series . These Leslies had louder solid @-@ state power amplifiers , and were mounted on casters for ease of portability . The first models Leslie manufactured were the 900 and 910 , which contained a 100 watt , three @-@ channel power amplifier . Both could split into two sections . The most popular version of the Pro @-@ Line series was the 760 . It was a smaller version of the 900 and 910 , and contained a 40 watt treble and 50 watt bass amplifier . A smaller , more portable version of the 760 is the 820 . It is a solid @-@ state cabinet like the 760 , and it connects to the organ with a 9 @-@ pin connector as well . However , it is only 31 inches (790 mm) high and has only a single rotor with a full @-@ range 12 @-@ inch speaker .

The Pro @-@ Line series was durable and fault @-@ tolerant , with many models lasting for years . However , because they used solid @-@ state amplifiers , they are not as highly regarded as the older tube @-@ based Leslies , because they lack the characteristic sound when the amp is overdriven .

The smallest Leslie is the Model 16 , made in 1970 . It has a Fender @-@ like speaker body and a rotating foam dispersion block . It was built for guitarists , portable , and had " Leslie " written on the front . It contained just a single 10 @-@ inch speaker , and was designed to be powered by an external amplifier , and contained an additional output for an extension speaker . Control of the

speaker was via two switches , one of which controlled the speed and one switched the rotors on and off . It was also released later as the Fender Vibratone .

= = = Hammond @-@ Suzuki = = =

As well as the 122A and 147A reissues , Hammond @-@ Suzuki now makes smaller and transportable Leslies using modern technology . The 2101 is 20 inches (520 mm) high and has a rotating horn as found on the 122 and 147 , along with a pair of 2 @-@ inch (51 mm) compression drivers and two 5 @-@ inch (130 mm) woofers . The unit provides two separate inputs so different instruments can be plugged into the rotary and stationary components respectively . The 2121 is a 15 @-@ inch (380 mm) stationary speaker that uses digital signal processing to emulate the rotating drum found in older Leslies . The 3300 is the same as the 2121 , but with a 300 watt power amplifier .

= = Sound generation = =

The Leslie is specifically designed , via reproduction of the Doppler effect , to alter or modify sound . As the sound source is rotated around a specific pivot point , it produces tremolo (the modulation of amplitude) and a variation in pitch . This produces a sequence of frequency modulated sidebands . To stop a Leslie 's rotor , a special brake circuit was added to the Leslie motor controls , that incorporated an electronic relay by producing a half @-@ wave of direct current .

Much of the Leslie 's unique tone is due to the fact that the system is at least partially enclosed , whereby linear louvres along the sides and front of the unit can vent the sound from within the box after the sound has bounced around inside , mellowing it . The crossover is deliberately set to 800 Hz to give the optimum balance between the horn and the drum , and is considered an integral part of the speaker . The tone is also affected by the wood used . Tone differences , due to cost cutting using particle board for speaker and rotor shelves instead of the previous plywood , are evident in the Leslie 's sound . The thinner ply of the top of the cabinet adds a certain resonance as well . Like an acoustic instrument , a Leslie 's tone is uniquely defined by its cabinet design and construction , the amplifier , crossover and speakers used , and the motors ? not merely by the spinning of rotors .

= = Miking = =

Because a Leslie speaker modifies as well as amplifies the sound , the output cannot simply be connected to a larger PA system if the volume onstage from the built @-@ in amplifier is too quiet . This is particularly problematic for an older Leslie like the 122 or 147 , which only has a 40 watt RMS power amplifier . Instead , microphones are placed around the Leslie , and the output from these is connected to the PA . A typical setup for onstage miking is to use two microphones placed on opposite sides of the horn and a single microphone on the drum .

Miking a Leslie is also important in a recording studio , as the choice and positioning of microphones determines the overall recorded sound . A popular recommendation is two Shure SM57s on the horn and a Sennheiser MD421 on the drum . Recording Magazine 's Dave Martin suggests a similar setup , with various microphone models used as stereo pairs on the horn but using an Electro @-@ Voice RE20 on the drum instead . Keith Emerson recorded his Leslie using a single mic each on the horn and the drum , but with the covers removed .

= = Clones and simulations = =

While the Leslie speaker is still made and sold , similar effects can now be obtained via analogue electronic devices and digital emulation . Chorus and phase shifter devices can give an approximation of the sounds produced by a Leslie speaker . The Univox Uni @-@ Vibe , a four @-@ stage phase shifter , was specifically marketed as a low @-@ cost Leslie substitute for guitarists , and used a foot @-@ operated fast / slow switch similar to the combo preamp . The

pedal was popular , and notable users included Jimi Hendrix , David Gilmour and Robin Trower , but vintage units tend not to be in good condition now due to the degradation of capacitors in the unit . Although the sound of a Leslie speaker heard in person is quite distinct , digital clones have become increasingly better at emulating it .

Most modern keyboards that emulate the Hammond organ also include a Leslie simulator , including Hammond 's own XK @-@ 3c and the Nord Electro . However , there is still a market for standalone simulators . The Neo Ventilator has been particularly praised for its accuracy in emulating the sound of a Leslie . Sound on Sound 's Mark Ashfield described it as " quite simply the best Leslie speaker simulator to date " , while a Keyboard Magazine reviewer was " blown away by how authentic the Ventilator sounds " . In 2013 , Hammond @-@ Suzuki started manufacturing their own Leslie simulator in a stomp box .

= = Notable users = =

Leslie never advertised his speakers . After demonstrating a prototype with Bob Mitchell , an organist with radio station KFI in Los Angeles , a contract was made to install another prototype in the station 's studios , where Mitchell would be the only organist authorized to use it . Mitchell was so impressed that he tried to patent the speaker , but discovered that he couldn 't . Soon afterwards , Mitchell became an organist with the Mutual Broadcasting System , and played a Hammond with the Leslie on its shows , ensuring national exposure for the sound . The Leslie was subsequently a standard component of several notable jazz organists , including Jimmy Smith , Jack McDuff , Jimmy McGriff and Shirley Scott . Graham Bond was the first notable British organist to play a Hammond through a Leslie .

In 1965 , Buddy Guy 's guitar amplifier stopped working while he was recording Junior Wells ' album Hoodoo Man Blues . Recording engineer Stu Black rewired the Leslie speaker in the studio to work with Guy 's guitar , which became a significant use of the guitar with the speaker .

Brian Wilson of The Beach Boys first recorded a Leslie in 1965 and used one for the title track of Pet Sounds , released the following year . The Beatles first recorded using a Leslie during the sessions for Revolver in 1966 . After John Lennon had asked for his voice to sound " as though I 'm the Dalai Lama singing from the highest mountain top " , Abbey Road engineer Geoff Emerick rewired the input of the studio 's Leslie so a vocal microphone could be attached to it . Emerick used this setup to record Lennon 's vocal on the track " Tomorrow Never Knows " and claims the Beatles subsequently wanted to record everything through a Leslie . George Harrison played his guitar through a Leslie on " Lucy in the Sky with Diamonds " and " You Never Give Me Your Money " . The Beatles subsequently inspired other guitarists to use the speaker . Eric Clapton used a Leslie on Cream 's song " Badge " , and David Gilmour used a similar setup when recording with Pink Floyd . Floyd 's Richard Wright played a grand piano through a Leslie for the introduction of Echoes on 1971 's Meddle . Guitarist Joe Walsh used the Leslie early in his career with the James Gang .