



Scanner and other effects

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For all those people who want to learn more about this extraordinary device: how it is done, how it works, its functions

Intelligent Projectors, better known as scanners, are so popular among the experts in the sector of lighting engineering, that almost everybody has acquired a correct and detailed technical language. Words like DMX512, dichroic filter, stepping motor, etc, are used in all commercial negotiations and underline the importance of offering a product with so many technical solutions. For those who would like to learn a little more about it and enrich their technical knowledge, we have thought of offering an informative dossier that will examine all the functions of a scanner and will give an answer to the many questions probably raised by this subject. What we observe when we see an operative scanner is a light beam that comes out from the body of the projector and is projected against a reflecting mirror, by moving forward and backwards (Tilt) or to the right and to the left (Pan), it changes the position of the beam itself. If we were in the place of the person ordering these functions to the scanner, we would easily carry out the same operations by acting on a potentiometer, by pressing a button or moving a joy-stick. The first thing that catches the eye, then, is that all the functions that a scanner can perform are controlled by a board that sends signals through a "umbilical cord" represented by a cable. In general, there are two kinds of communication signals with a scanner: analogue (0,10V) or digital (DMX512, RS-232). We shall briefly go into the details of those communication systems, by saying that the DMX512 (as already mentioned) is a "computer" type signal, while the more classic and older 0,10V must link up with a converter that translates it in digital and send it to the scanner. In the 0,10V mode each channels corresponds to a wire that transports its orders, while with serial communication just 3 conductors are enough. Before going into the body of our scanner, if we observe with attention we will notice behind the mirror two stepping motors which allow two movements, Pan and Tilt. The role played by the stepping motors is fundamental in a scanner and, as we shall see, they allow all the movements of the various functions.

Stepping Motors

Unlike a normal motor, which runs increasingly faster as the power increases, the stepping motor once supplied does not move, or better it does so with a small step. The stepping motor has two main components: the rotating part (rotor) in the middle and the fixed part (stator) on the outside. The rotor comprises an even number of (delta-shaped) and alternatively positive and negative arms; the stator, located around the rotor, is an electromagnet which according to the direction of the current will either become positive or negative. Since it has two separate power supplies (even and odd arms), the rotor exploits two circuits which are powered individually with direct current and allow one positive pole of the rotor to position itself at the opposite pole of the stator. Such movement will take place step by step in one direction or the other according to the action performed on the

power supply of the two circuits. Therefore, it is not possible to talk about power but pair. What makes this kind of motor a good performer of the order given by a board is the fact that the two circuits it exploits use the same computer science principle. The most commonly-used stepping motors for scanners can reach a maximum of 200 micro-steps per revolution.

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Optic group

The moment to open the scanner and to have a look inside to understand what causes all these functions that are so special has arrived. At first we will notice a series of electromagnetic and optic components placed between the two extremes represented by one side of the lamp (or the reflector) and by a lens. It is quite useless to repeat how important is the role of the optic group in a projector. In the case of the scanner, high quality techniques and components are used with the purpose of producing a well defined and, at the same time, powerful projection. There are two different theories on how to choose a lamp and the right light diffusion. Considering that the great majority of available scanners make use of 575 or 1200W metal halide discharge lamps (the more commonly used are HMI and MSR ones), the efficacy of lamps with bipolar connection and rear reflector is often debated, especially with regard to lamps with a socket connection and a wrap-up reflector. In the first case, on the front side of the linear lamp there are two condensing lens treated with special coating, which resist to high temperatures and make possible to obtain a very uniform and powerful spot. Because the reflector has not got a wrap-up structure, the disadvantages of this solution comprise the loss of part of the beam on the sides, as well as another small percentage that is absorbed by the condenser. In the second case, with a connection with bipin base and the lamp inserted in a wrap-up reflector, the luminous flux is exploited to its maximum, but it is very difficult to obtain a uniform focusing. One can support either one or the other solution, which must be taken into consideration when choosing a projector: in the case of the SGM producers, the scanner Galileo IV Live 1200 and the whole Galileo family adopt the first solution, while the moving head projector Giotto Wash 1200 adopts the second one. The light beam, after breaking down the condensing lens and passing through a series of "obstacles", duly interposed to obtain the special effects, will end its journey inside the body of the projector by going through a lens for the (manual and mechanic) focusing which will determine the width of the projection angle according to the nature of the lens that it comprises. The last part of the optic group is the external mirror, which is often treated with highly reflecting special paints.

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Special effects

As we were saying, a not very definite number of wheels, plates, filters and other things are inserted between the lamp and the objective in order to be able to project figures, colours, shot and rotating shapes: they are the special effects. The more they are the more prestigious our scanner will be.

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The gobos

For a reason based on the focusing, the first wheel after the lamp is usually the one with the gobos. They are small metal or glass discs resistant to high temperatures that represent drawings and figures. Installed on a wheel fixed on the axis of a stepping motor, and positioned in the middle of a light beam, they make possible the projection of what they represent (names, drawings, logos, etc.). If the wheel does not remain fixed on one gobo but

is left to rotate at different speeds, we will obtain the projection of all the images present on the wheel and an effect of the beam projected in the air that continuously changes its form and dimension. The more "equipped" scanners have rotating gobos in the two directions with variable speed which enable to obtain a double image/movement effect. In the more sophisticated and professional scanners, dichroic gobos are also used, they are created with the technique of the coloured filters on which images are impressed. In this case we will have the image/colour/movement combination, which is very useful for the specific projection, for instance, of a famous logo which must be re-proposed with the colours that characterize it. Most gobos are interchangeable (both metal and dichroic ones) thanks to the fitting up on the wheel of different systems that vary according to the manufacturer. It will thus be possible to take advantage of hundreds of different and not excessively expensive solutions to change projections at will. The presence of a few gobo wheels, moreover, allows to superpose images thus considerably enriching the light effects without any limit to the fantasy of the light designer.

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Dichroic filters

Dichroic filters are set on a wheel similar to the gobo wheel, they provide colours to the light beam of the scanner which after passing through the gobos will go through these coloured glasses.

But what is a dichroic filter? Let's try to explain it briefly. The dichroic filter has a very particular technology. It consists of placing on the glass, by means of evaporation in vacuum, a very thin transparent film that is quite different from the one used on mirrors. In this way, an optic phenomenon of coloured iridization with vivid and pure hues takes place. The dichroic filter does not act by mere "colouring": the light that passes through it, in fact, is partially repulsed and that that goes through it takes on the colouring. For this reason when we observe a dichroic filter on a surface it looks like it is reflected.

The introduction of these elements was necessary because of the high temperatures reached by the light produced by discharge lamps. Classic jellies, in fact, are not able to resist to such temperatures, whereas the dichroic filter can reach 4000°C. A colour wheel can contain 4 or 5 colours with a diameter that reaches 5 cm. On lower category products 10/12 colours are used with on very small diameter. Obviously, the wider the diameter of the filter, the larger the light emitted by the projector. There is no precise and fixed distance from the light source where to place the colour wheel, however, it is always advisable to use, as much as possible, a narrow beam, to ensure that it goes through the filter, as much as possible, and that it is perpendicular as much as possible in order to have a homogenous projection. The wheel with the dichroic filters, just as the gobo wheel, can position itself precisely on one colour, or over two adjacent colours to create bicoloured rays, or rotate continuously at a variable speed to obtain the rainbow effect. Multicoloured filters are also available to obtain as many effects as possible. Finally, we can mention how important it is to find the right balance between the colour temperature of the lamp and the dichroic filters. Indeed, denser or "harder" colours (e.g. dark red or blue) will never be very luminous, while by dosing the power of the lamp it is possible to obtain very good light pastel chromas.

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Prisms

In the last few years, not many to be true, (fixed or rotating) prisms too have introduced among the special effects of scanners. They are very thick and heavy glass lens, faceted in various forms, which enable the light beam to multiply the projected image. There are classic as well as curious types. The most commonly used are those with 3, 4, 6, 8 facets,

that can offer the multiplication of the image according to the number of facets. If, for instance, we are projecting a circle, by inserting the 4-facet prism we will obtain 4 circles that will cover a wider surface compared to that of a single circle. The 9-facet prism, for instance, superposed to the rotating 4-facet prism makes possible to obtain an extraordinary tridimensional effect of the image. With this example, we have introduced the subject of rotating prisms, which requires a few words of explanation. As with the rotating gobos, this is an Italian technique. It uses the same principle of the gobo, apart from the weight of the lens, but the intuition is that if we provide a supplementary rotation to an already moving image we can obtain very high quality tridimensional effects. How many solutions are at our disposal to create a light show with a scanner with 8 super-imposable rotating gobos, 76 colours, 3 prisms, 2 of which rotating ones? Answer: around 6,000, or better, anything that you have in mind.

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Other effects

There is another very light wheel with particular filters: they are filters that convert the colour temperature. The use of conversion filters permits to obtain "warmer" or "colder" colours. In the first case a 3,200°K filter is used, in the second case a 5,600°K one. In general, a UV filter and a frost type filter are also fitted on this wheel, this enables the diffusion of the light beam by creating "fogs" with a very evocative colour. The UV filter permits to obtain the classic "Wood light" or "black light". The dimmer, on projectors with discharge lamp, is made of a number of plates that close the light. The blade of the shutter is often used to achieve the strobe effect with variable speeds, even synchronized to music. The diaphragm (iris) permits to vary the circumference of the emitted beam until it is reduced to a point. The electronic or manual focus is indispensable especially in scanners that create a higher number of effects.

As we have seen, it's incredible what can be created with this kind of projectors. We feel we can affirm that only a few constructors on the market supply so many effects. We are not providing any classification based on merit: we leave this arduous task to you!

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