The Colormatic Printer

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The making of 16mm color prints from color original reversal by the internegative system is more difficult and exacting than making reversal prints. Black-and-white equipment must be extensively modified, or new color equipment must be built. This paper describes in detail a new high-speed production printer for making positive prints from the internegative, and outlines problems involved in its design and construction.

When 16mm internegative became available, many people thought it would be much simpler to process and handle compared with the reversal color duplicating or Kodachrome duplicating process. It was also assumed that it would be possible to convert black-and-white processing machines, printers, etc., in order to handle the color material. While some of these assumptions are, in a way, true, many of them simply have not worked out. For instance, in our laboratory where we run both the Kodachrome and negative/positive color processes, at the present stage of the art it is much easier to get consistent results from Kodachrome than it is from the internegative system.

It is also true that printing and processing equipment can be revamped on occasion so that it can be used to print and process color. However, in our case, most of the printing and processing equipment was already in use and there was little advantage in converting equipment. It was preferable to build new. At the present time we are making color internegatives on a step printer which was, and is, used for making black-and-white duplicate negatives and Kodachrome prints. By some conversion in order to get more light it is possible to make color internegatives using this machine.

Continuous release printers for printing internegatives to color positive and processing machines to handle the material have been built especially for the purpose. We have under construction a new step printer for making the internegatives which may give better results than those obtained from the present negative printer. Thus, while it may be possible to convert existing equipment for the color negative/positive process, if the best and most economical results are to be had it is highly desirable to use equipment which has been designed and built specifically for the purpose.

It is not possible here to discuss step printers, release printers and processing machines, so discussion is limited to the continuous printer for making release positives from color negatives and soundtracks. The printer which we have designed and built is known as the Colormatic Printer (Fig. 1).

In building such a printer we had these objectives in mind:

1. Speed. The initial objective was a printer that would run as fast as possible. This objective was soon modified to "as fast as practical." We found that we had enough light to print up to 1000 ft/min and the results were the same as if the printer had been run at a lower speed. It was not practical to run at the highest possible speed because the take-ups presented a serious problem and, more than that, the operator was not able to keep up with the machine. We therefore settled on a speed of 250 ft/min which seems practical.

We attempt to make all internegatives contain the light changes, optical effects and color changes, so that we end up with a one-light negative for release printing. It seems much more economical to do it this way and occasionally make over a negative which is not correct rather than to try to operate light or color changes while printing from the negative. To put such changes in a release printer would mean running it at a much lower speed with resultant complications. In order to get the maximum amount of work consistent with the least wear on the negatives, the printer runs in both directions.

The printer has four raw-stock magazines so while a print is being made in one direction the operator can unload the print which has just been made and reload the raw stock into another of the magazines to print in the reversed direction. With these considerations, a speed of 250 ft/min is apparently the most practical.

2. Production of prints as nearly perfect as possible. In order to get a good print, it is, of course, necessary to have good contact and the smaller the area which must be brought into contact when two films are placed together the better the contact.

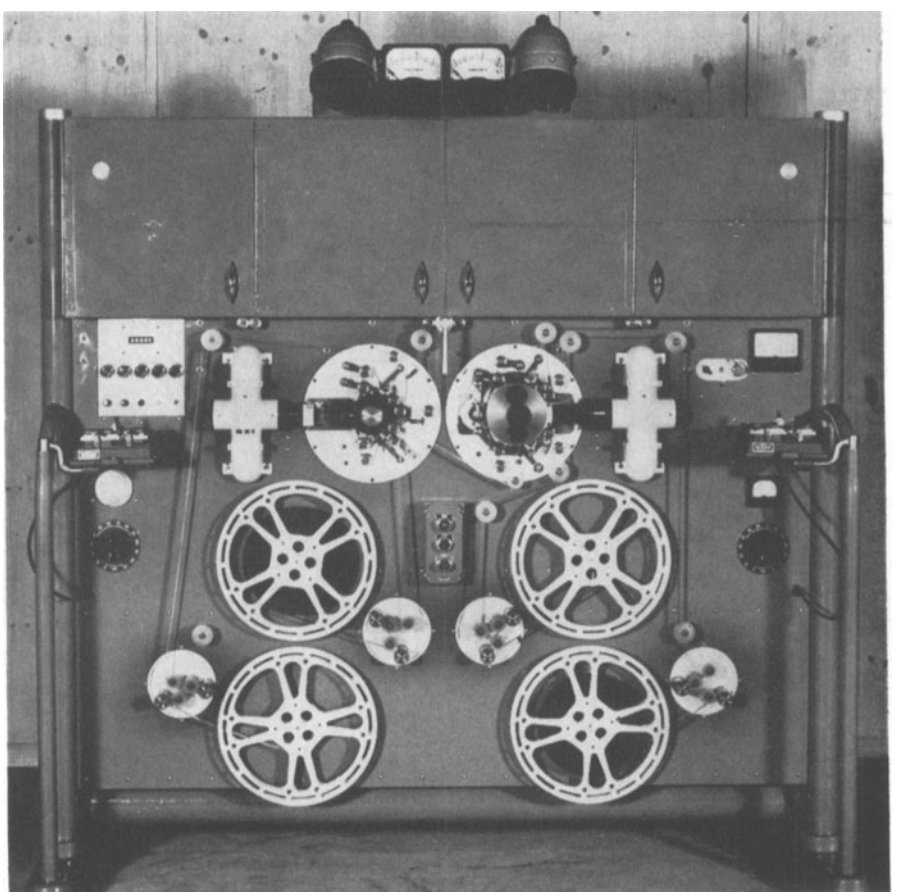

Fig. 1. The Colormatic Production Release Printer.

Presented on October 20, 1958, at the Society's Convention in Detroit by Lloyd Thompson (who read the paper) and Kenneth B. Curtis, The Calvin Co., 1105 Truman Rd., Kansas City 6, Mo.
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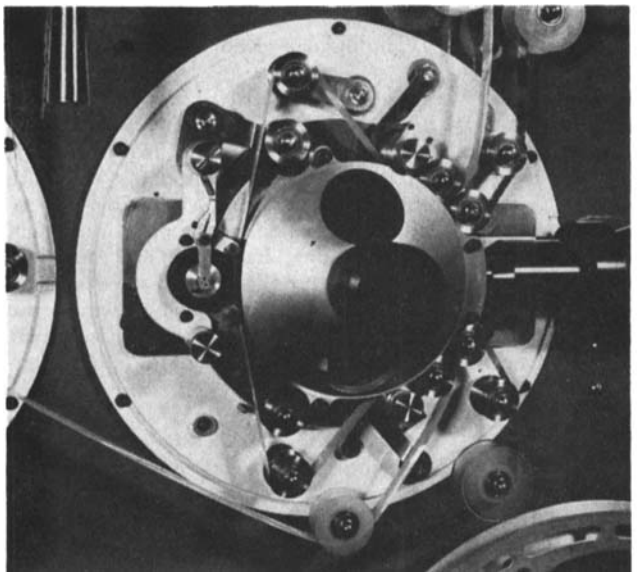

Fig. 2. Printing head. A 60-tooth printing sprocket is used to provide space for large filters.

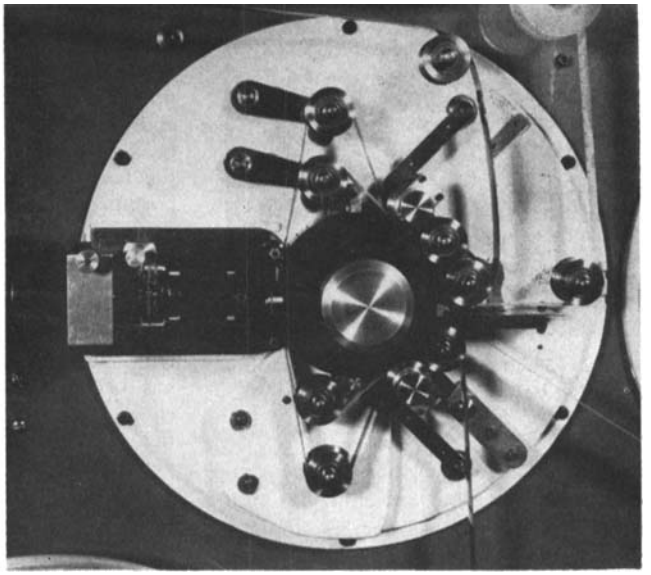

Fig. 3. Soundtrack printing head.

While designing this particular printer we built one printer with excessive contact. As a result, we were troubled considerably with Newton's rings so the design was changed. The new design seems to give good contact without too much trouble with Newton's rings, providing the negatives have been sprayed. This type of printer is very steady. In a printer of this type, the necessary filters present a problem.

In order to print at the required speed, it is necessary to have a concentrated light source, and when this is provided the filters must be placed at some point in the system where the minimum amount of heat is transferred to the filters. This location is in the printing head. To provide space for larger filters, a 60-tooth printing sprocket is used (Fig. 2). Placing the filters at this point eliminates the curl problem of the filters, but the concentrated light going through the filter begins to change the characteristics of the filters after about two days' use. Eastman Kodak Co. recently introduced acetate filters which could be used for this purpose, and these are entirely satisfactory and much less expensive than the regular gelatine filters. In order to guard against any color change we put in a new set of filters each day. The choice of optics provides a uniform light system. The timing belt drive and the 60-tooth sprocket make uniform printing conditions.

Another head is used for printing the sound and in this case we have gone to something which is unorthodox, and which would not have worked a few years ago (Fig. 3). We know because we tried it. When we first began printing sound in the 1930's from 16mm originals, we had a printer which used a negative on the outside of the sprocket rather than on the inside. This means that the raw stock was on the inside and the negative was on the outside. At that time the sprocket was inadequate and because of the shrinking characteristics of 16mm materials the printer was not consistent in its results. A suggestion made by Eastman Kodak Co. on an experimental printer, which John R. Capstaff built, led to the type of printing now used. Both a picture and a sound head using this principle were built. It did not work out for the picture, but has been entirely satisfactory for the soundtrack printing. We have had such a system in operation for almost two years. According to measurements on the soundtrack printed on this printer, contact and movement-wise, it seems to be entirely satisfactory. Movement is very good, which makes for good reproduction of the negative track and the contact seems to be very good. Densities of a release print made from a specific negative have a much wider range of usable densities on this printer than on other optical or contact printers which we have in use.

We have designed and cut our own sprockets for this machine. The picture head has a 60-tooth sprocket and a free-wheeling companion rail which equals the base diameter of the sprocket (Fig. 4), both of which are balanced. The purpose of this companion rail is to carry the unperforated side of the film in parallel to the sprocket while leaving an open path between them for the printing light. Since single-perforated films receive a one-sided pull a jittering effect may be noticed, especially if only one or two narrow teeth are engaging the film and the films are being dragged between pressure gate rails. This effect is relieved when there is a greater engagement of full-width sprocket teeth, shaped to conform with the film movement, and all rails contacting the films are free-moving.

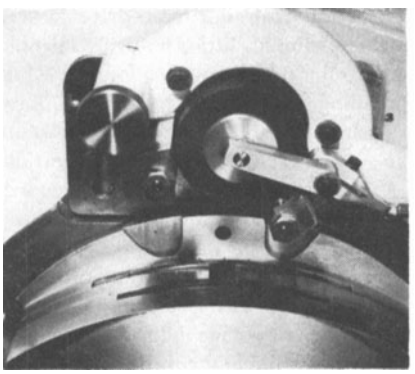

Fig. 4. Printing sprocket, traveling rail and pressure roller.

When both the sprocket and the free-wheeling rail shafts are mounted on preloaded ball bearings for positive non-defective alignment, the stability is improved. Since the aperture is large and actually a ghost image of one located elsewhere there is no streaking caused from dirt. There is no stroboscopic or ladder effect caused by the narrow aperture and the use of alternating light current and very little friction. Consequently, there is little wear — insuring long life to that part of the machine.

3. Maintenance of a consistently high standard. A release printer running at a high speed must be able to repeat accurately and consistently. In order to maintain a high standard, the best components obtainable have been used. Unfortunately, it is not possible to use a synchronous motor drive because of the necessity for controlled acceleration which, in connection with an automatic starting feature, repeats the determined rate of acceleration each time the printer is started. The motor maintains a uniform and accurate speed. Equally as

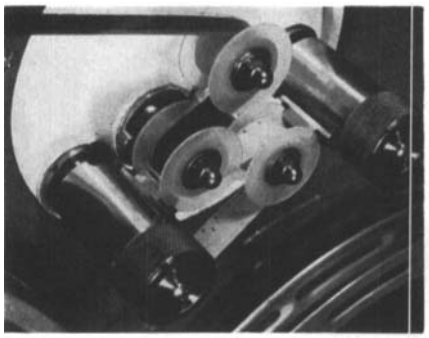

Fig. 5. Vacuum cleaners for cleaning negative before and after printing.

important as acceleration is the machine's deceleration and stop. To omit any means of control for its stopping would cause the printer to become unthreaded, and the reels thus freed would spin wildly. It was found that the only installation necessary was a good, reliable, electro-magnetic power brake in connection with the main-drive system plus one simple, little, no-drift, solenoid brake on each reel drive for use when threading the printer. Snubbers have been installed only for absorbing minute shocks in acceleration and deceleration.

Only the most reasonable safeguards have been incorporated in the take-up system, using partial compensation to correct for the excessive pull of empty raw-stock cores at the start and ending of a show. A two-stage adjustable voltage supply is available for those drives which serve alternately as take-up and supply according to the direction of the run. These motions are never electrically reversed. Reel and core shafts are a direct extension of the motor shafts with no mechanical reduction.

A footage counter with an automatic shut-off mechanism also has been built into the printer. This means that the printer can be set up to print to any given length and automatically stopped at the same point each time in the leader section. Once set, the operation is automatic in both directions. It relieves the operator of the necessity of catching the end of the run and also saves footage because printing is not extended beyond the length needed. This feature is important in a high-speed printer. This device is made useful for printing sections by merely setting it for the desired length. It automatically shuts off when it reaches a predetermined point.

Expanded scale meters are used on the lamp current. In addition, a Densichron has been installed on the machine to check both the amount and the color of the light. Light sources are checked periodically in this manner. The Colormatic operates entirely on alternating current which seems to result in better regulation.

4. Maximum number of prints with minimum wear. Color internegatives are expensive and difficult to make so that once a negative which gives good prints has been made it is desirable to make as many prints from this one negative as possible. All possible measures are taken to protect the negative. Except in actually printing the picture, picture area does not come in contact with anything other than raw film, either on emulsion or base side of the film. Vacuum cleaners have been installed to clean the negative both before and after printing (Fig. 5).

The cleaning is done before the film goes on the take-up reel so as to prevent dirt and foreign matter from being rolled up in the negative and sticking to it. Rewinding negatives seems to wear them out almost as fast as printing so the printer has been built to run in both directions to assure a minimum of wear and to save rewinding and threading time.

Threading film in and around the two printing gates and onto the machine is a most exacting and tiring task at best. It aids production as well as preserves the negatives against wear caused by unnecessary handling and rewinding if this operation is performed only once, at the beginning of a given run of prints.

5. Long, hard service with few repairs to the machine. A production printer should require little attention. Down time is extremely costly because not only are the printer and its operator idle but so, all down the line, are other facilities such as processing, inspection and shipping. For that reason, component items are all of top quality. Parts which might cause trouble from rust and corrosion are made of stainless steel or some other noncorrosive metal.

Such parts as bearings for the printing sprocket or other bearings were made extremely heavy and oversized, and as accurate as possible. The aim was to build a printer which when once adjusted would run for weeks or even months at a time without maintenance, other than cleaning and checking.

6. Easy to operate. We wanted a printer that would be easy to operate. Experience and statistics prove that people work more efficiently and become less tired under quiet, comfortable conditions. We therefore made an attempt to build a machine that would operate quietly and, in this, we feel, we have succeeded fairly well because it is much more nearly silent than many of our slower running printers. We operate the printers in individual rooms and these rooms are sound-conditioned as well as air-conditioned and humidity controlled. Attempts have been made to place the equipment where it is most convenient for the operator to use; and whenever there are indications that changes will make operation less tiring, then such changes will be made.

It is, of course, impossible to anticipate the future or do too much advance designing, so it will be interesting to see what changes have been made in such equipment in twenty-five years from now. All we can say with certainty is: we know it will be different.