Automated Book Replicator

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Abstract- The project aims to develop an attachment that can be incorporated to the existing reprographic machine for taking the photocopy of bound volume automatically. The automated scanning of pages is a latest upgradation of the reprographic machine. The system reduces time consumption in copying thereby reducing monotony in workers and the employer can minimize the number of workers. Since being an attachment it can be incorporated to the existing system without much alteration. The operation is easy since less complex mechanisms are employed thereby no special technical skill is required for operation. The system has been successfully tested and can be converted into a commercial product.

Keywords – Photostat machine (Reprographic machine), attachment, clarity, health hazards, monotony, payback time.

I. INTRODUCTION

Based on market survey conducted in various Reprographic Shops, it was found that taking the photocopy of a bound volume was tedious & time consuming. The operators (especially women who are employed in majority of the reprographic shops) are prone to heat produced due to radiation emitted from the machine as they have to spend a large amount of the for copying of bound volume. As for the concern of reprographer, time is money that faster the work done, less will be time consumption. Electricity Consumption can also be reduced to a certain extend. This brings significant savings in labour and machine idling time. An additional attachment that can be incorporated to the conventional Photostat machine is proposed. By saving time we are also saving electrical energy i.e., the overtime operation of the conventional machine is reduced. It aims to redress the limitations of the existing reprographic machine which is as follows.

• To minimize the time required to take the Photostat of bound volume.

• To reduce the monotony of operators.
• To improve the clarity of pages copied.
• To reduce overtime operation of the conventional machine.

The system is designed and the model is made. The system on testing gave positive results. The product can be made as a commercial product.

II. PROCESS ADOPTED

1. MODELLING

The problem definition leads to the idea of AUTOMATED BOOK REPLICATOR. After the idea generation the various processes required for the product and its components are determined. The modelling is done in CATIA V5. The various motions involved in the system are.

Table1.1 The main components and their motion.

Sl.no	**Component**	**Motion**
1	Ram / Book holder	Reciprocating (top to bottom)
2	Page Separator	To and fro
3	Page Turner	Rotary

CASING

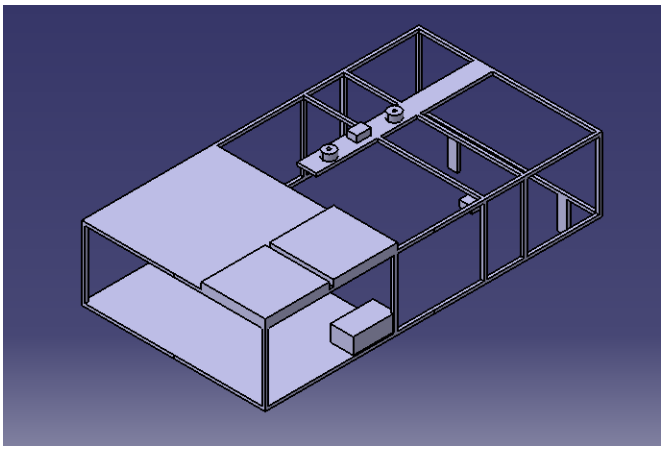

Fig. 1.1a Model of Casing.

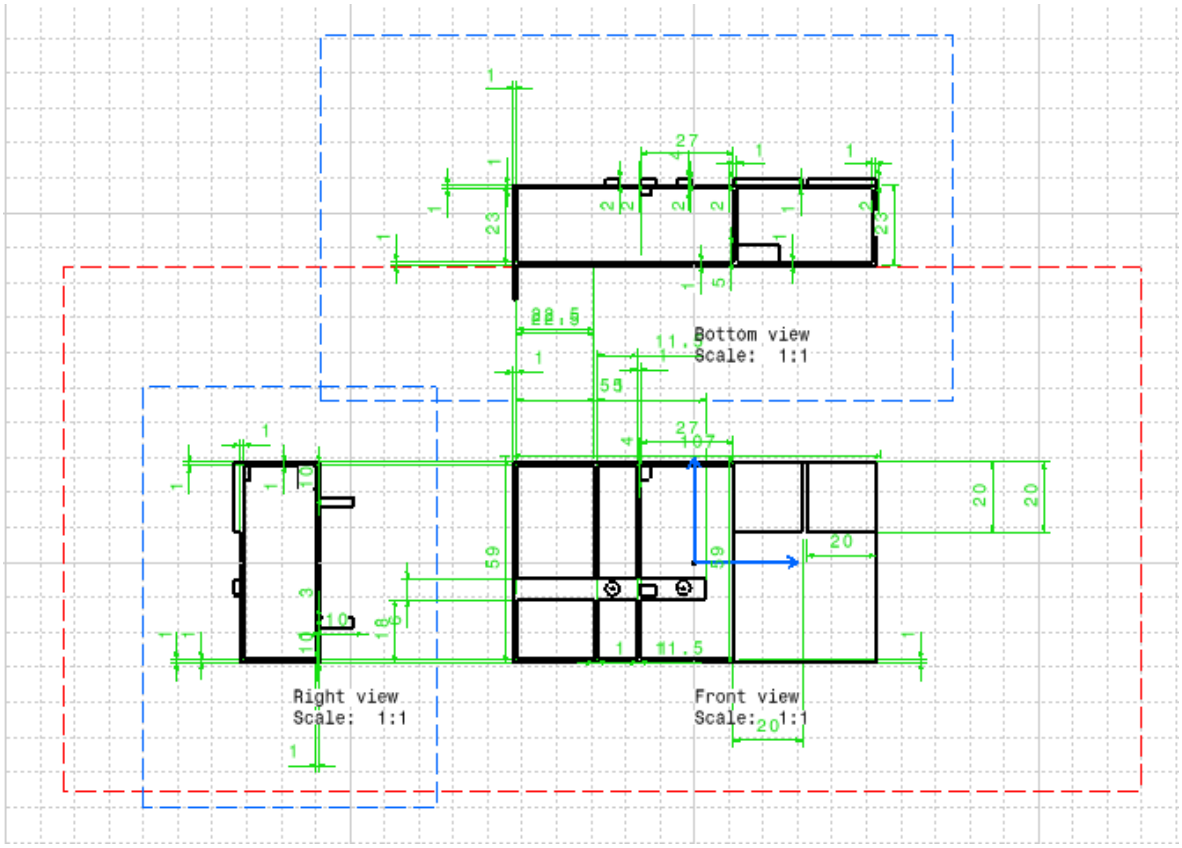

Fig 1.1b Draft of Casing

The outer casing is covered black in order to enhance scanning efficiency. The outer casing is designed so that it can be fixed as an attachment with 2 screws. The page counter is used to count the number of pages scanned. This is to notify the operator about the completion of work. The timer circuit will help to arrange all the operations on time. The number of pages is initially set. When each page is turned, the counter circuit counts and notifies the user when the scanning of the required number of pages is completed.

RAM

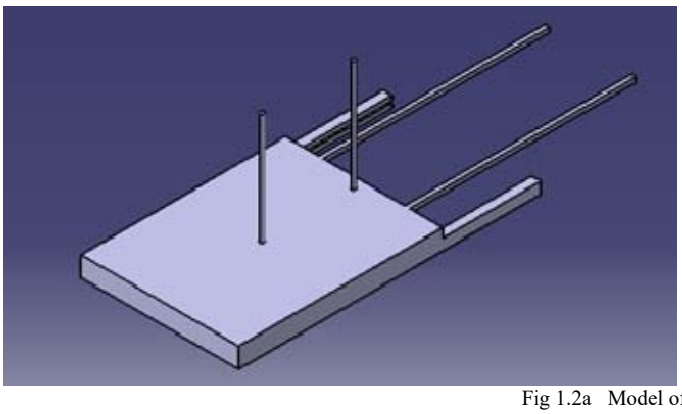

Fig 1.2a Model of Ram

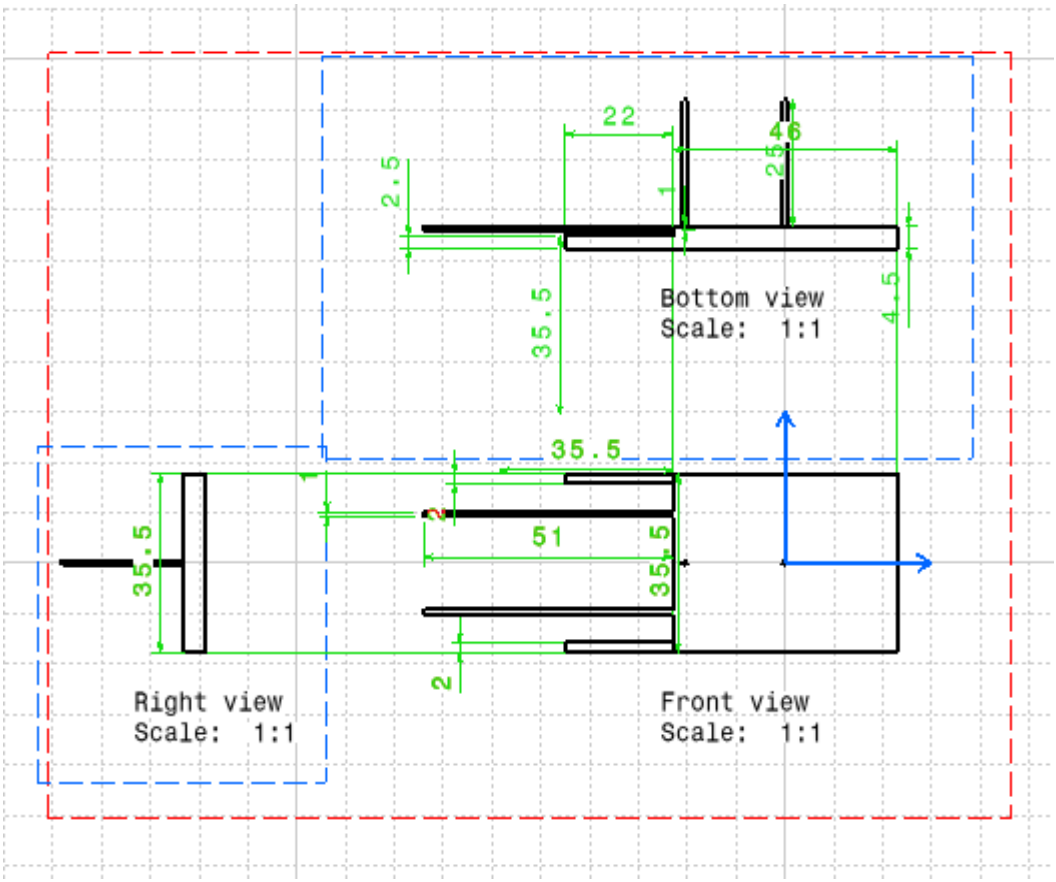

Fig 1.2b Draft of Ram

The cross section of the reciprocating ram is rectangular. It is motor assisted (servomotor).The book is held on the ram. The book is clamped on both ends with spikes on one side to enhance the book grip. A central support is provided using a string. The ram is made white in color to enhance the quality of the Photostat. Length of stroke fixed as per dimension of the text to be copied.
Time for oscillation: 6s (to and fro).

PAGE SEPERATOR

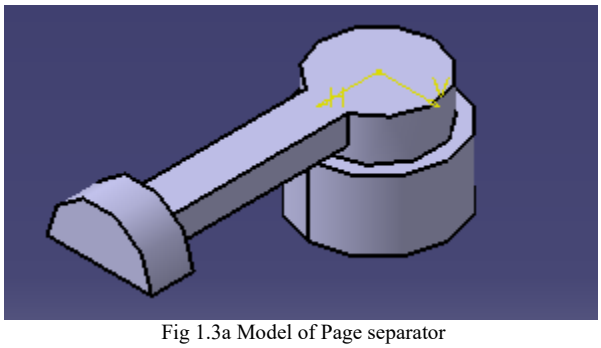

Fig 1.3a Model of Page separator

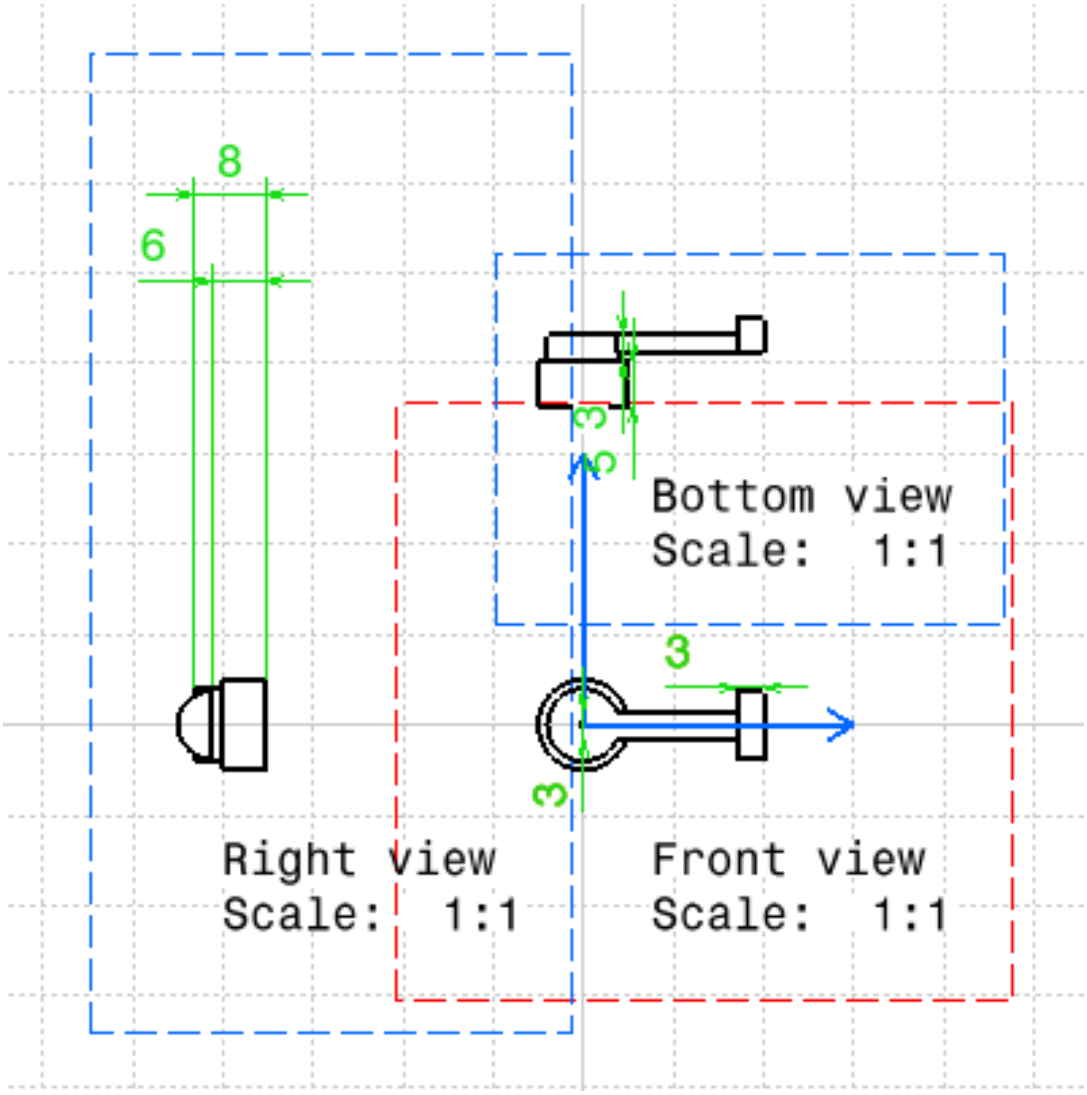

Fig 1.3b Draft of Page separator

The page separator consists of a base and a cantilever with a rubber roller at its end. The cantilever can rotate 360^0 about an axis. During its rotation the rubber roller comes in contact with the book. Due to the friction page gets separated.

PAGE TURNER

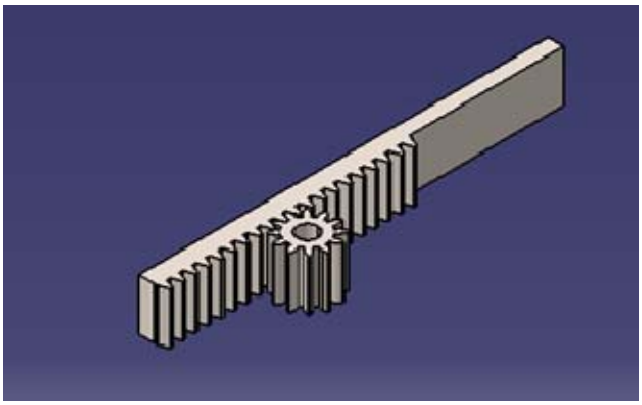

Fig 1.4a Rack and Pinion arrangement of turner.

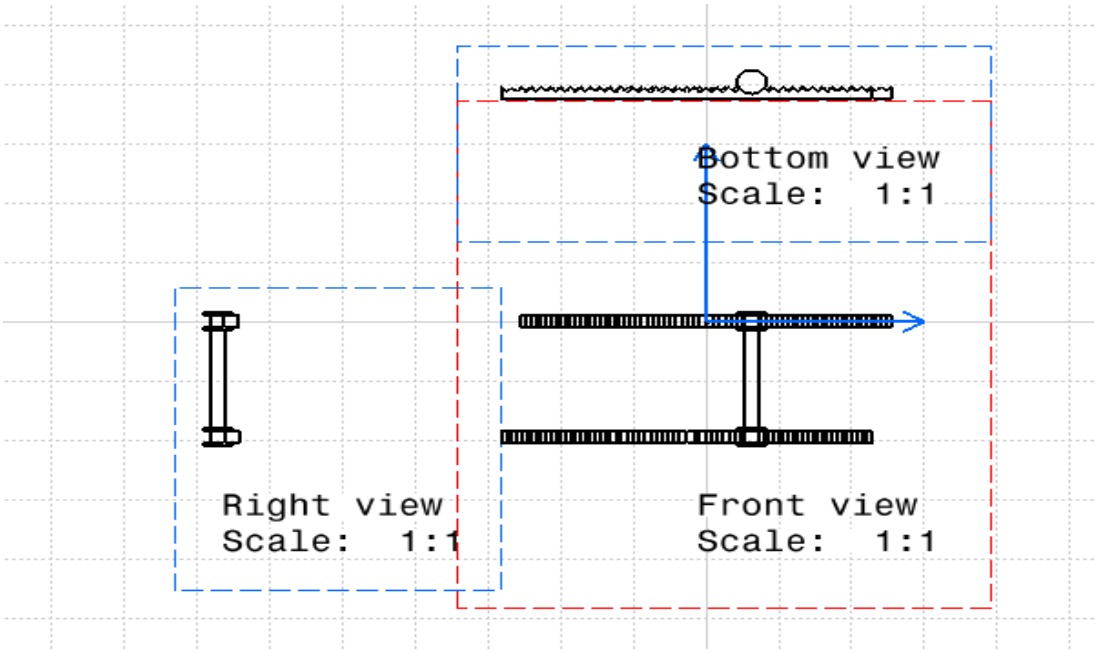

Fig 1.4b Draft of page turner

The page is turned with the help of a glass with a roller at one end. The roller is made of rack and pinion which is powered by a servomotor. This allows a to and fro motion of the glass. The motor runs at 45 rpm. It takes approximately 14 seconds for the to and fro motion of the glass.

Advantages of using glass:

1) Transparency provide 100 % scanning efficiency
2) Simple mechanism

2. *WORKING*

The book is placed in the holding device, the device is provided with an adjustable holding mechanism so that books of varying size can be held. After holding the book the ram moves down and the current page is scanned. It is retracted back, during which the page separator gives out a single page which is turned by the page turner assisted by a rack and pinion (motor driven). The ram returns back and completes the scan. The process is repeated for the intended number of pages. Once the required number of pages are scanned an alarm gives an indication so that the work can be stopped. Once the work is completed a conveyor mechanism takes the pages to the cutting and punching section. The ram is moved up and down using cams.

The working stages are as shown below:

1) Setting the number of pages to be scanned:

The number of pages to be scanned is initially set in the counter. This circuit consists of an IR LED sensor which detects the completion of scanning of a page. An alarm is given at the end of the whole process. A total of 9999 pages can be given at a single time.

2) Placing the book in reciprocating ram

The book is held in between the clamps and a central support is given at the middle. Spikes are given at one end. The book is placed in the holding device, the device is provided with an adjustable holding mechanism so that books of varying size can be held. The one end of the book is held by the page counter. The ram moves down and the current page is scanned. It is retracted back, during which the page counting mechanism gives out a single page which is turned by the blower. The ram returns back and completes the scan. The process is repeated for the intended number of pages. Once the required number of pages are scanned an alarm gives an indication so that the work can be stopped.

3) Separation of pages:

After scanning the initial page, the ram moves upwards. The next step is to turn the page. For that a page separator is used to separate a single page. The separator consists of an arm with a rubber roller at its end so as to have perfect grip on the paper to be turned.

4) Turning the pages

The separated page hang down due to gravity effect. This page is turned by using a glass of 0.5 mm thickness which is roller assisted. The to and fro motion of the glass is guided using a rack and pinion. The speed of the motor used is 100 rpm.

5) Downward stroke of the ram

The scanning of the turned page is done and the process is repeated up to the number of pages fed by the reprographer. When the number of pages set is completed an alarm is given to notify the reprographer about the end of the process.

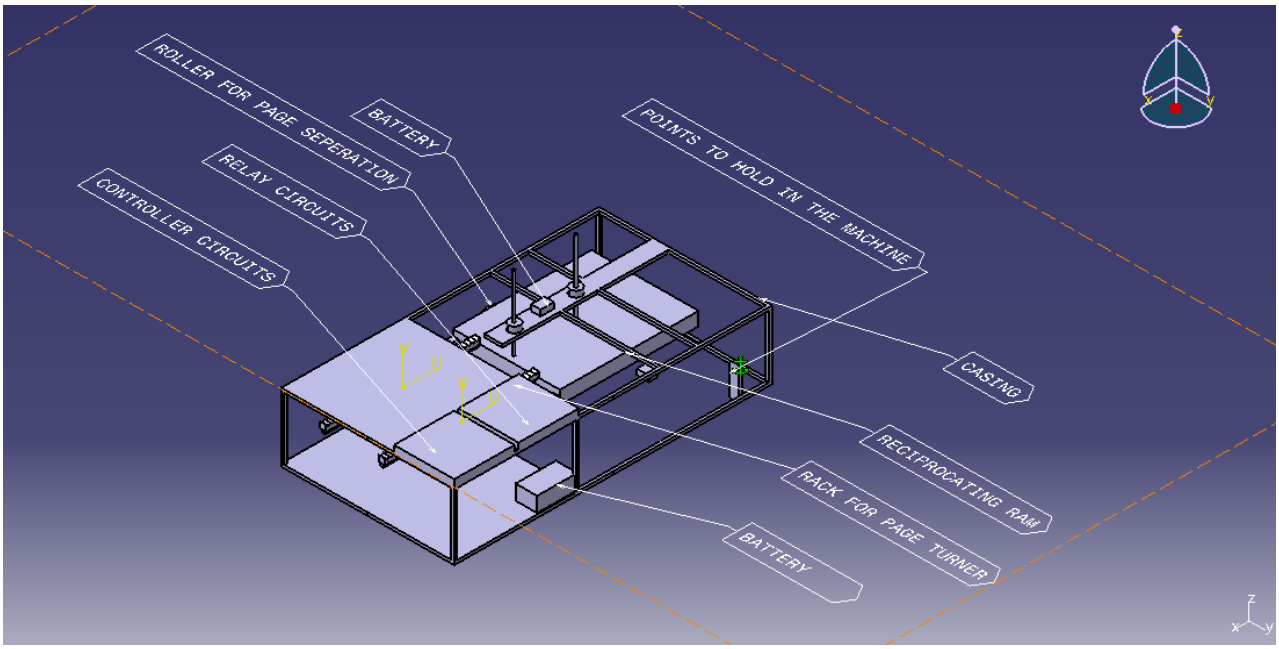

Fig 2.1 Assembly view of the components

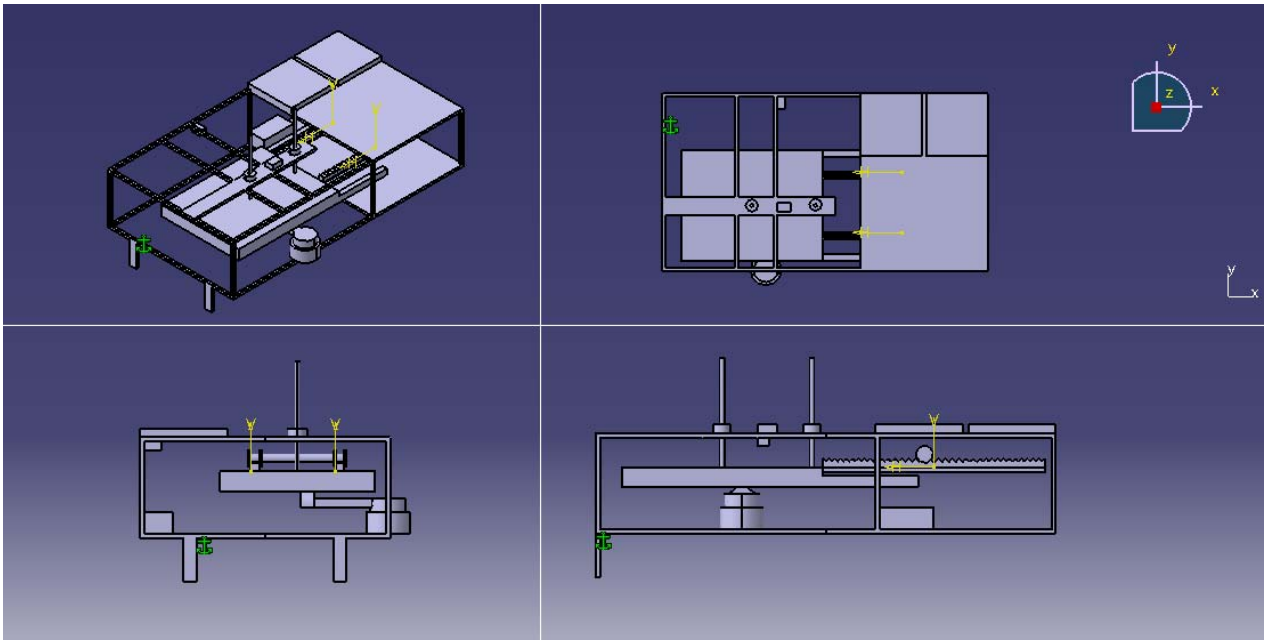

Fig 2.2 Different views of the machine attachment.

3. *RESULTS AND DISCUSSION*

1) Payback time calculation

Time for operations in the book replicating attachment
Reciprocating motion of ram, t1= 3s (top to bottom)
To and fro motion of glass, t2= 4s (right to left)
Page separation, t3= 3s
Total time before scanning, t=t1+t2+t3= 10 s
A normal employee takes a minimum of 12 s for the same.
Therefore 2 s savings in one page copying.
For taking 100 pages, thus we can save up to 3 minutes.

A minimum of 40 books arrive in a reprographic shop with an average of 50 pages.
Thus total pages =40*50=2000.
Therefore time saved for 2000 pages =20*3=60 min = 1hour.
Thus it will prevent late hours of work and gives an extra hour for work which means more income.
It also helps to save half unit daily thus in industrial point of view Rs. 5 daily.
Thus for 1 year Rs.1800-2000.
Total cost of manufacture =Rs.10000, Rs.8000 in bulk production.
Thus in a period of 4 years the pay back is obtained.

By taking extra work in the one hour work saving we can easily attain the pay back.
Also the shop keeper do not need to pay the overtime charges to the worker. This also added to the profit.
Using this attachment an employer can minimize the number of employees which also adds to the profit.

2) ADVANTAGES

- Affordable
  The overall cost of making the machine is less and hence can get a greater reach in market. Small farmers can afford such a product and employ it at their farms.
- Less maintenance

As there aren't complicated mechanisms employed the need for maintenance is also less. If there are faults, they can be resolved easily.

- Manually operated.
  As the machine works on cam, there isn't any electrical power requirement.
- Technical skills independent
  Does not require any technical skills and the machine is easy to operate.
- The attachment can be easily incorporated to an existing machine.
  The lid of the existing reprographic machine is detached and the attachment is placed on top of the machine.
- The attachment enhances faster and energy efficient performance of reprographic machines in schools, college, hospitals, etc.
- This can also be introduced in banks for enhancing the pass book entry system

3) SOCIO ECONOMIC RELEVANCE

- Faster replication of binded book.
- Eliminates the monotonous job of the worker.
- Can save lot of time.
- Saves electricity.
- Since being an attachment it can be easily installed in existing machine.

4) HEALTH HAZARDS ELIMINATION

- Protects hazards of vision by the scanning rays since the system is completely closed.
- It protects the reprographer from the hazardous rays of the machine since the presence of the reprographer is not needed in the vicinity of the machine.
- The covering eliminates the noise coming out of the machine

III.CONCLUSION

- Since being an attachment, it can be easily incorporated to the existing reprographic machine.
- Faster replication of bound volume as the system is fully automated.
- As less complex mechanisms are employed, operation is easy.
- Requires no special technical skills for operation as simple mechanisms are employed.
- Improved clarity of pages copied is obtained as an extra force is applied on the middle portion of the book that is copied.
- Will prevent health related hazards to the reprographer.
- Prevents overtime works.

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