

POWER TRANSMISSION BELTS

IP LANDSCAPE STUDY

Sample Report



Invent

→ Search → Prosecute → Issue →

Monetize

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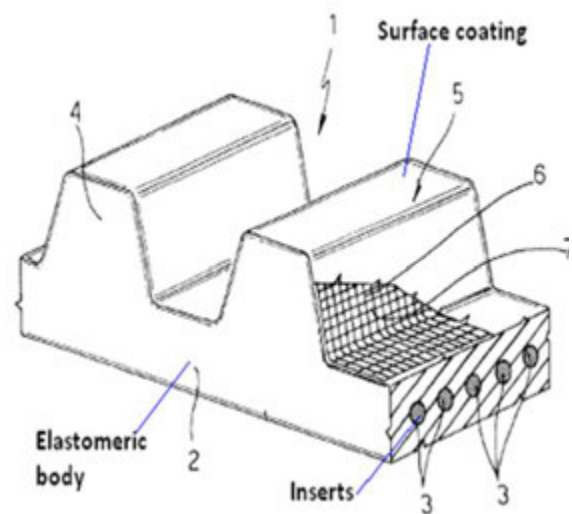
1. OBJECTIVE

The objective of this IP landscape study was to identify in-force patents (US&EP) and published applications (US, EP & PCT) related to power transmission belts (Synchronous/V-belts).

2. SUBJECT OF THE SEARCH

A power transmission belt (Synchronous/V-belt) comprising:

- a body made of elastomeric material which includes at least one polymer selected from the group consisting of ethylene- α -olefin, nitrile, acrylonitrile, urethane, polyurethane, hydrogenated nitrile butadiene rubber, polyurea and urea
- a coating/fabric/film adherent to the working surface of the belt in order to ensure the necessary resistance to abrasion and maintaining an adequate flexibility of the belt when it is winding onto the pulley and also improving the characteristics of belt strength
- resistant inserts/cords embedded inside the body to strengthen the belt and having a high power of transmission



3. SUMMARY

A comprehensive search was performed to identify companies with relevant patents¹ related to power transmission belts.

A total of 659 patent families, which includes 1047 unique patents/applications, have been analyzed² of which, we shortlisted **291** patent families (one patent per family) that disclose synchronous and V-type power transmission belts used in a number of diverse environments such as automobiles, agricultural equipment, and domestic electrical equipment.

The 291 patents/applications have been analyzed further for the elastomeric materials used in the construction of the main body of the belt (such as ethylene- α -olefin, nitrile, acrylonitrile, urethane, hydrogenated nitrile butadiene rubber, polyurethane, polyurea and urea), the tensile member (carbon or graphite fiber), types of belt (synchronous & V-belts) and the coating/fabric/film applied to the working surface of the belt. An overview of the distribution of patent families across the above categories with number of IP assets has been depicted in [Figure 1](#).

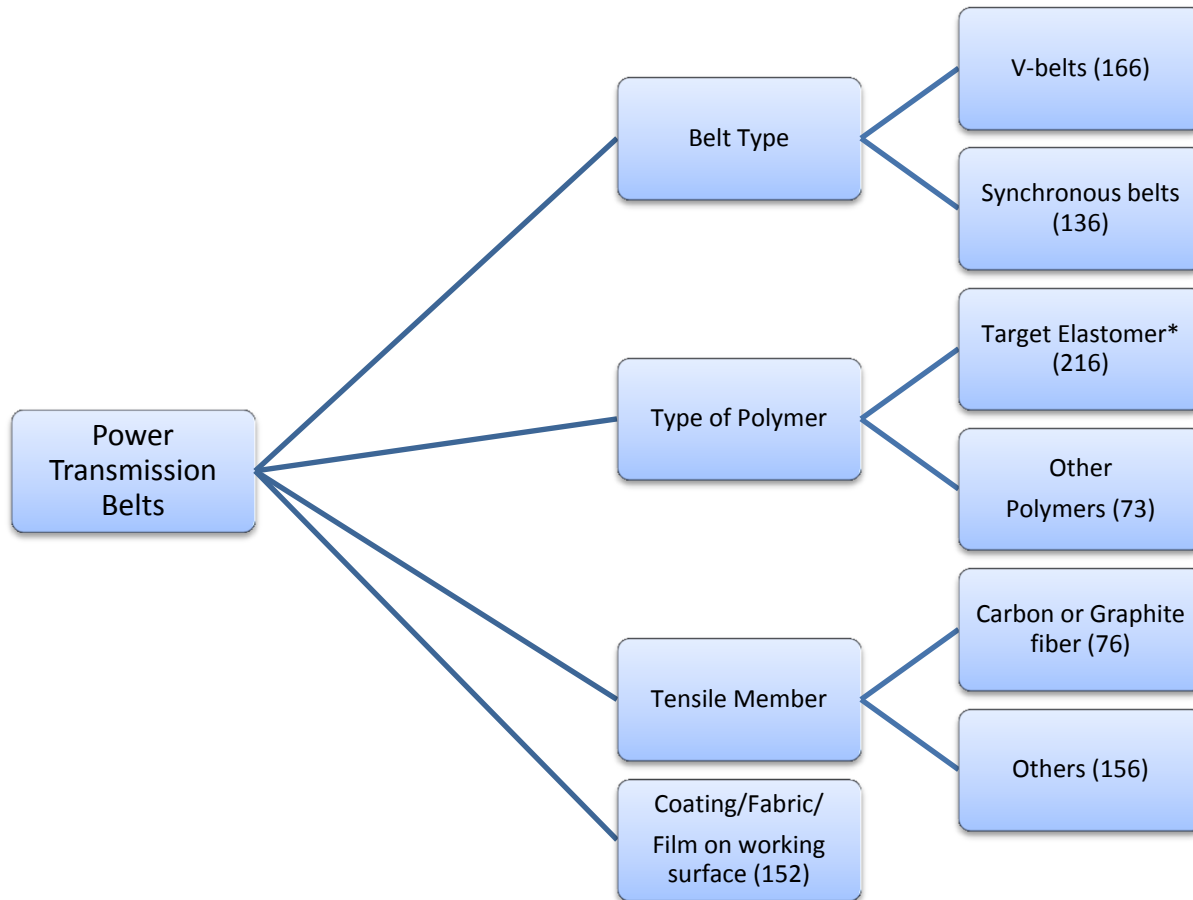
As shown in [Figure 1](#) among the identified patent families in each category, 74% of the patent families call for the target elastomeric materials used in making main body of the belt such as ethylene- α -olefin, nitrile, acrylonitrile, urethane, hydrogenated nitrile butadiene rubber, polyurethane, polyurea and urea, 52% are disclosing coating/fabric/film applied to the working surface of the belt and 26% call for tensile members.

¹ By patents, we mean issued patents (US & EP) and published applications (US, EP & PCT)

² One patent per family has been reviewed for relevancy.

Figure 1: Distribution of Patent Families

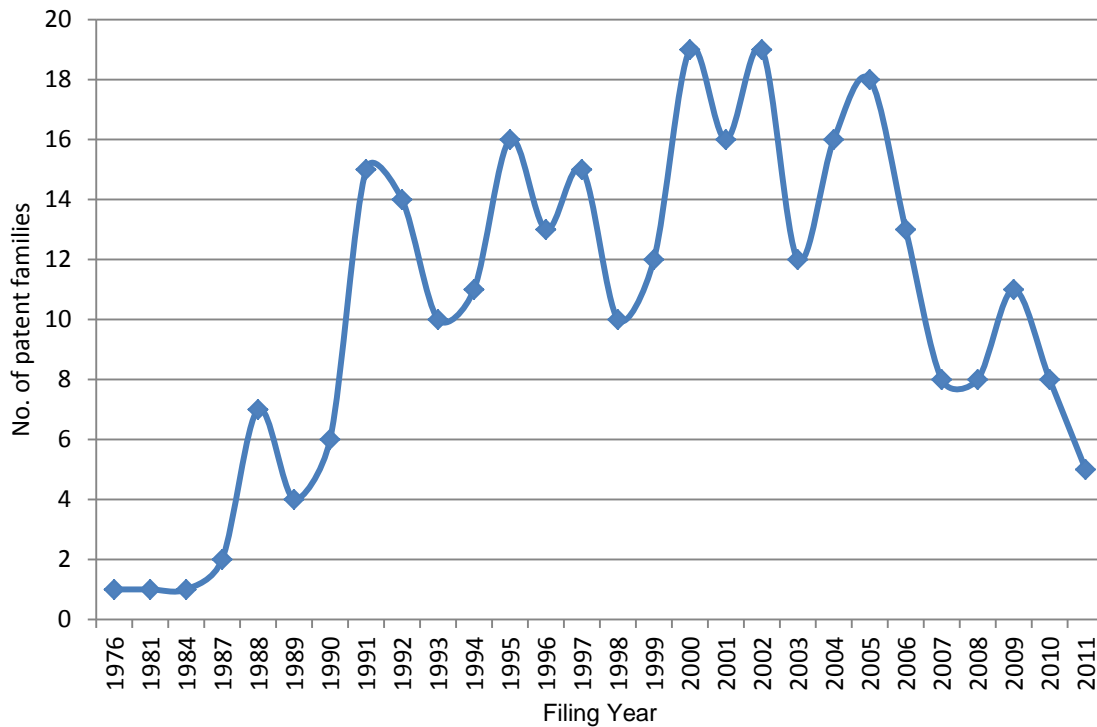
[Number of patent families indicated within the parentheses for each category]



* - Ethylene- α -olefin, nitrile, acrylonitrile, urethane, polyurethane, hydrogenated nitrile butadiene rubber, polyurea and urea

3.1 Filing Trends of Patents and Applications

Figure 2: General Filing Trends³

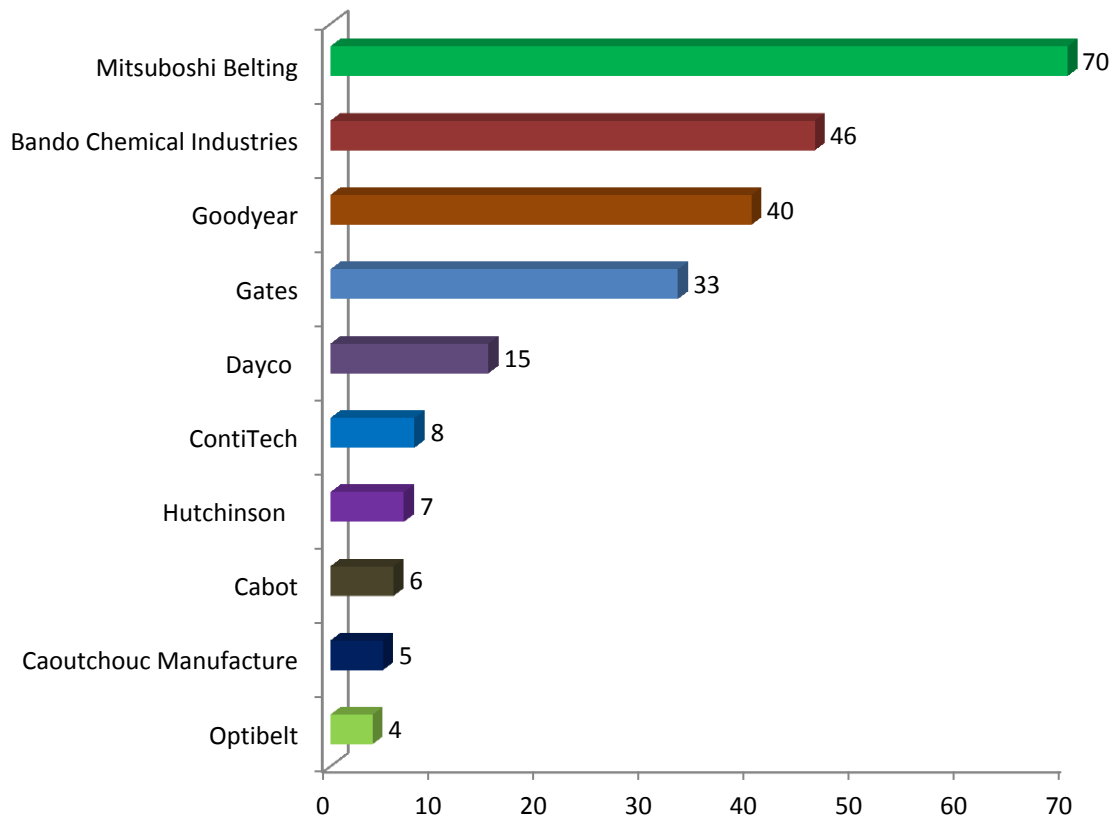


- ❖ [Figure 2](#) shows the number of patents filed by various companies on power transmission belts particularly synchronous and V-belts. This figure shows increased filing activity in the years 1991 to 2006.

³ As of April 30, 2012. Number of IP assets for filing trends, key assignees, inventors and technology evolution has been obtained using the shortlisted 291 patents/applications (One patent per family).

3.2 Top 10 Assignees

Figure 3: Distribution of IP Assets across Top Ten Companies



- ❖ In [Figure 3](#), Mitsubishi Belting Ltd. is the dominant player based on the number of IP with 70 patent families followed by Bando Chemical Industries Ltd. (46), Goodyear Corporation (40)⁴, Gates Corporation (33)⁵, Dayco Products Inc. (15)⁶, ContiTech AG (8), Hutchinson (7), Cabot Corporation (6), Caoutchouc Manufacture et Plastiques (5) and Optibelt (4)

⁴ As per the recent USPTO assignment data 26 patents of Goodyear Corporation have been re-assigned to JPMorgan Chase Bank, N.A

⁵ 24 patents/applications of Gates Corporation are re-assigned to Wilmington Trust FSB, as Collateral Agent as per the recent assignment data

⁶ 5 patents/applications of Dayco Products have been re-assigned to Deutsche Bank AG, London Branch as per the recent assignment data

3.3 Top 10 Inventors

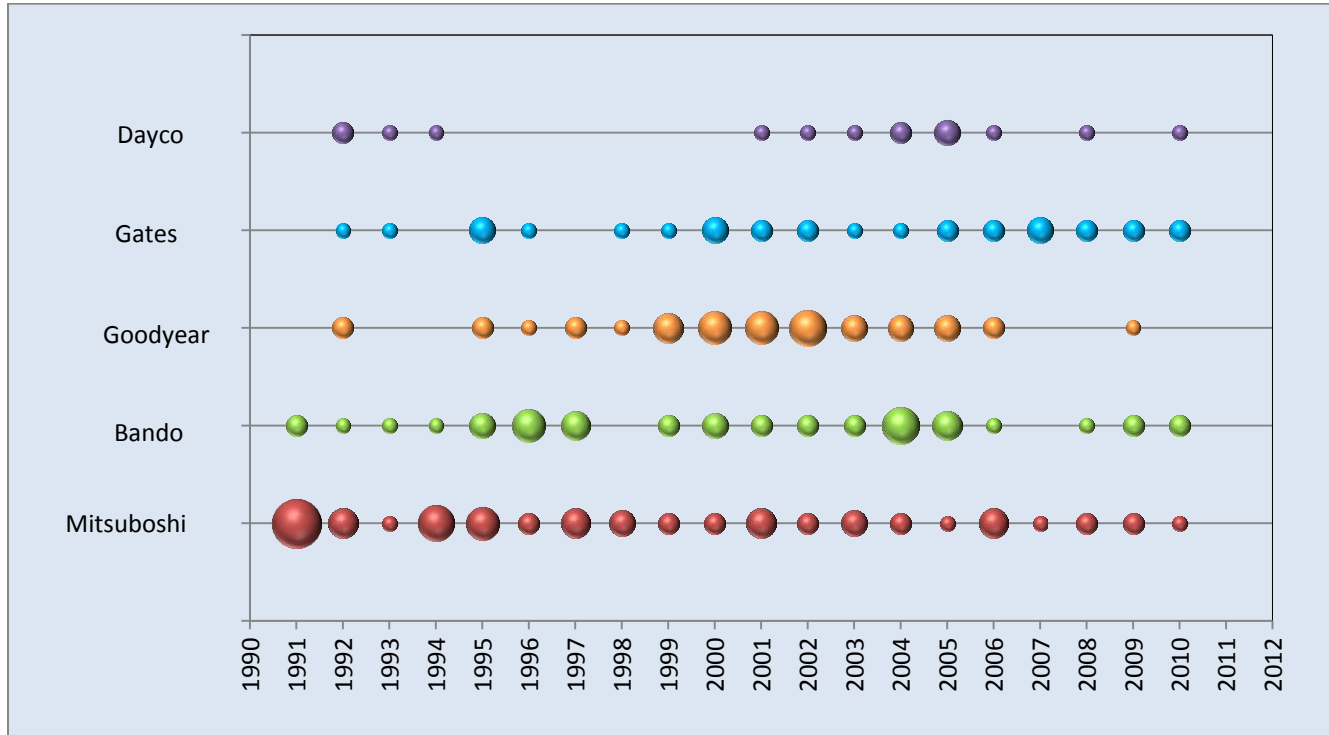
Table 1: Key Inventors

| # | Top Inventors | No. of IP Assets | Associated Company |
|-----|----------------------|------------------|------------------------------------|
| 1. | Mishima; Kyoichi | 10 | Mitsuboshi Belting Ltd. |
| 2. | Kinoshita; Takashi | 9 | Mitsuboshi Belting Ltd. |
| 3. | Gregg; Michael J. W. | 7 | The Goodyear Tire & Rubber Company |
| 4. | Hasaka; Hitoshi | 7 | Mitsuboshi Belting Ltd. |
| 5. | Nakajima; Masayoshi | 7 | Mitsuboshi Belting Ltd. |
| 6. | Hineno; Yorifumi | 6 | Mitsuboshi Belting Ltd. |
| 7. | Kumazaki; Toshimi | 6 | Mitsuboshi Belting Ltd. |
| 8. | Nakashima; Eijiro | 6 | Bando Chemical Industries, Ltd. |
| 9. | Okuno; Shigeki | 6 | Bando Chemical Industries, Ltd. |
| 10. | Osako; Nobutaka | 6 | Mitsuboshi Belting Ltd. |
| 11. | Shiriike; Hiroyuki | 6 | Bando Chemical Industries, Ltd. |
| 12. | Teves, Reinhard | 6 | ContiTech Antriebssysteme GmbH |

3.4 Filing Trends of Top 5 Assignees

Figure 4: Filing Trends for 1991-2011

(Note: Bubble size in the chart denotes number of patent grants/published applications)



- ❖ [Figure 4](#) shows the graphical presentation of the filing trends of the top 5 assignees, number of patents filed over a period of last 20 years (1991 – 2011) related to synchronous/V-type power transmission belts.
- ❖ As evident from the graph, application filings have been gradually increasing from 1995 onwards and are at peak in the years from 2001 to 2005.
- ❖ Companies such as Mitsubishi Belting Ltd. and Bando Chemical Industries show upsurge in their patenting activity since 1991 while Goodyear Corporation and Dayco Products Inc. have shown decrease in filing activity after 2006.

3.5 Technology Evolution

Figure 5: Technology Evolution- Target Elastomer*

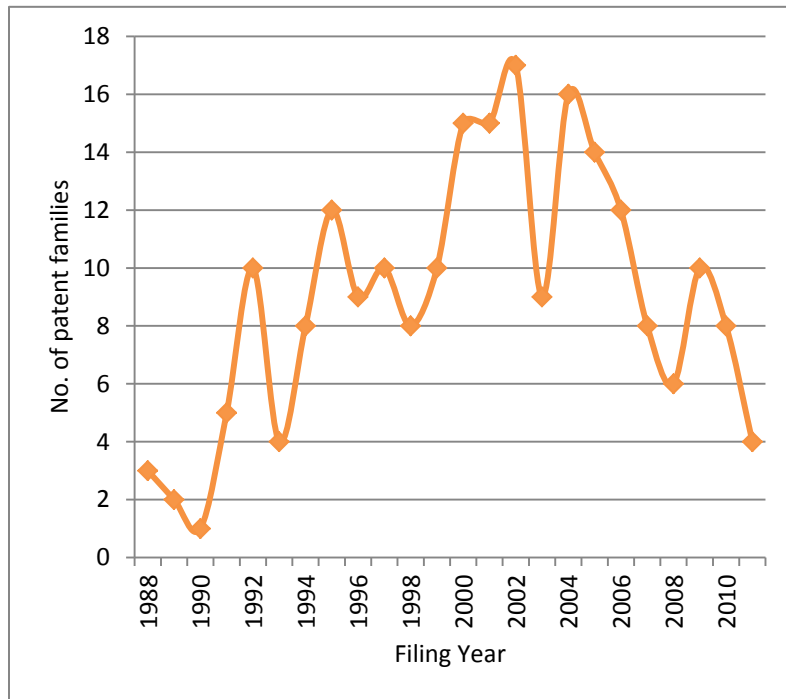
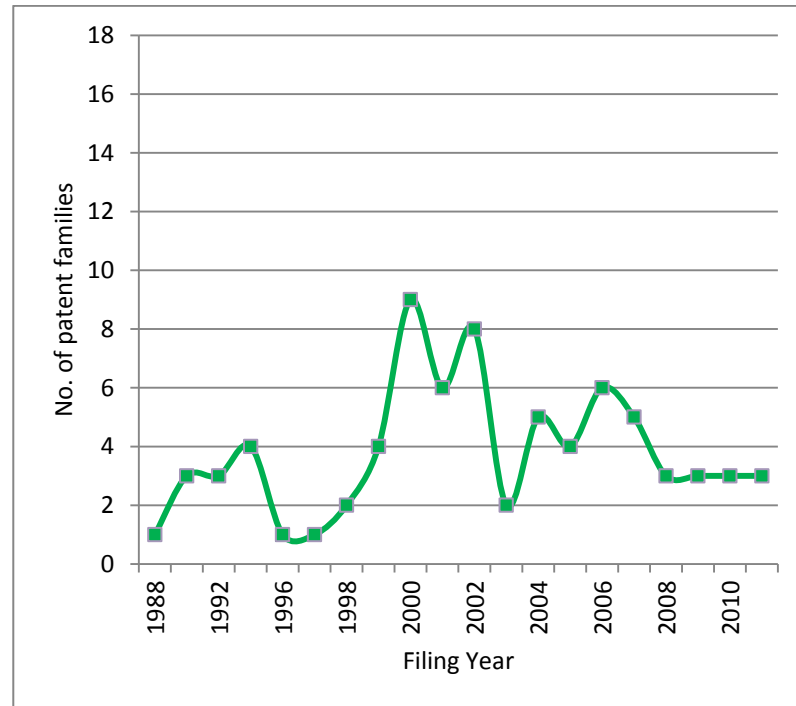


Figure 6: Technology Evolution–Target Tensile Member#



* - Target polymers include ethylene- α -olefin, nitrile, acrylonitrile, urethane, polyurethane, hydrogenated nitrile butadiene rubber, polyurea and urea

- Target tensile member includes only carbon or graphite fiber

Figure 7: Technology Evolution - Type of Belts

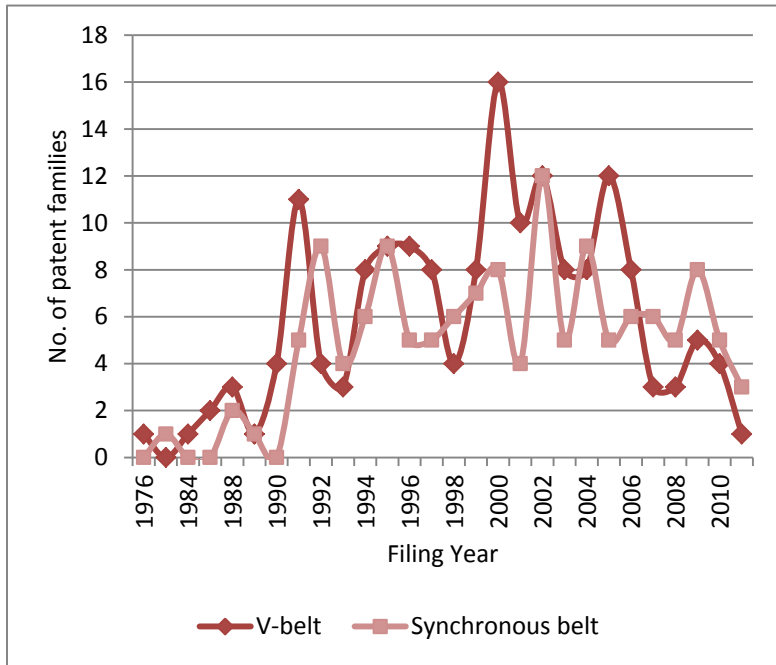
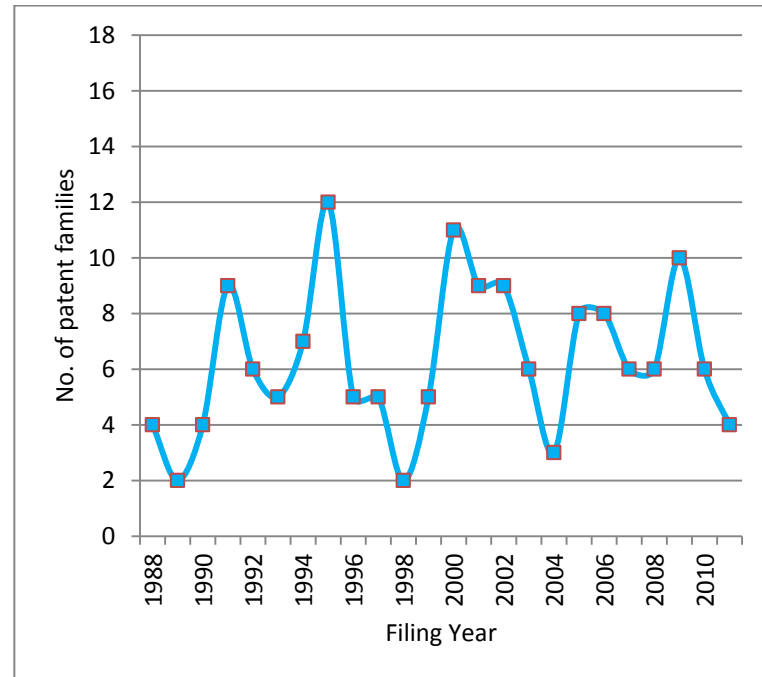
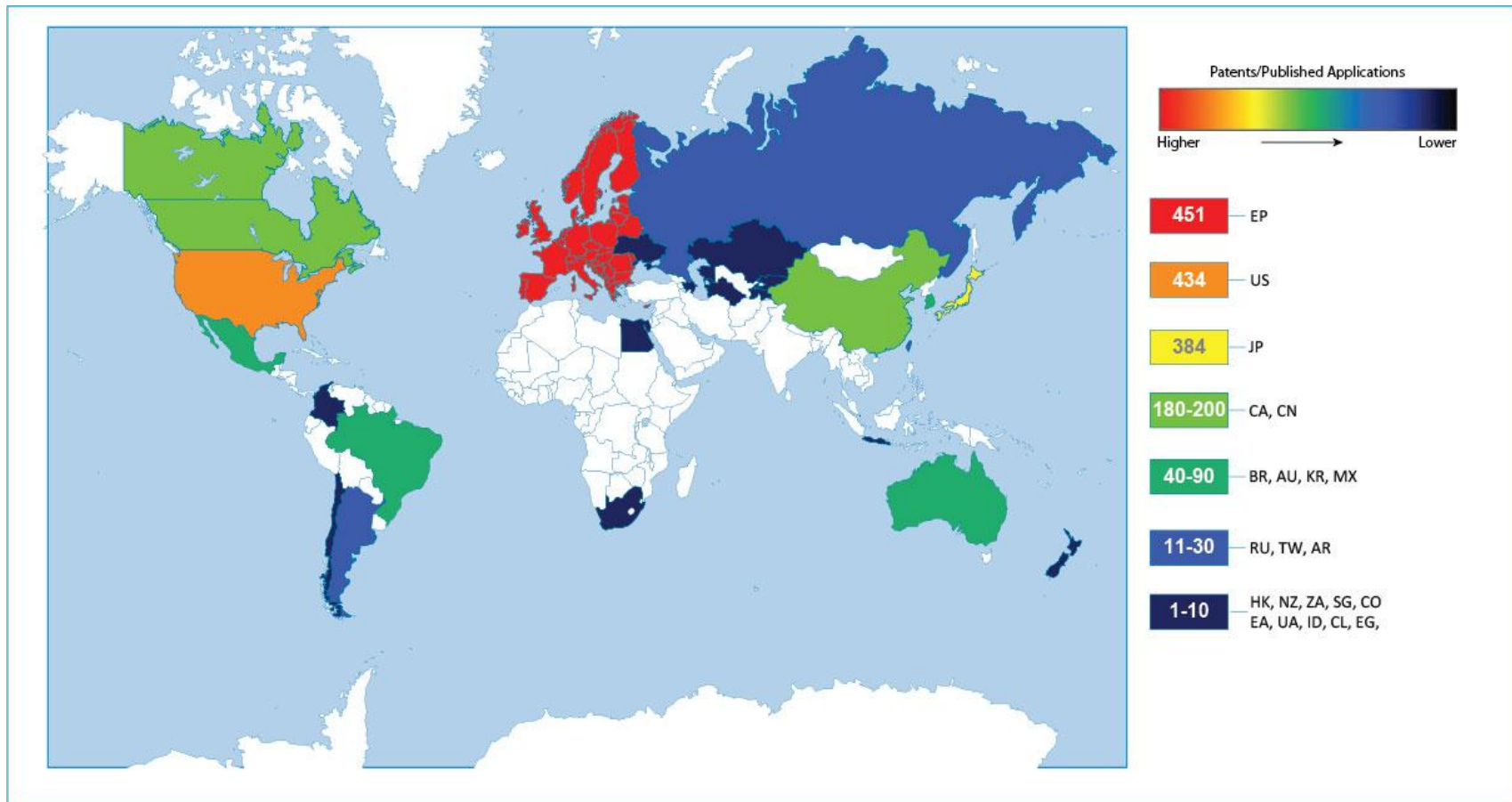


Figure 8: Technology Evolution – Surface Coating/Fabric/Film



3.6 Geographical Distribution of Patent Filings across the Globe

Numbers⁷ of patents and publications worldwide related to power transmission belts particularly synchronous and v-belts are depicted in the map given below separately.



⁷ Number of IP assets given within the appropriately colored boxes. A total of 2765 patents/applications from the 291 shortlisted patent families have been used to generate this map to show worldwide patenting activity in the subject area.

4. SEARCH STRATEGY

- ❖ Search was performed in Delphion (to identify patents and published applications) using various search strings listed in [Appendix](#)
- ❖ Search strings were formulated by combining various keywords, synonyms and technical phrases as shown in [Appendix](#)
- ❖ A total of 659 patent families (1047 unique hits) has been retrieved from the proposed search strings and reviewed one patent per family based on the earliest filing date
- ❖ Classification of the shortlisted references in the review process based on the technology interest as outlined in the subject of the search

5. SEARCH RESULTS

- ❖ An overall representation of the search findings and distribution of shortlisted patent families related to power transmission belts have been depicted in [Figure 1](#)
- ❖ [Figure 2](#) gives an overview of the general patent filing trends for companies in this space
- ❖ Concentration of IP assets of the top 10 assignees are shown graphically in [Figure 3](#)
- ❖ [Figure 4](#) shows the general IP filing trends of top 5 assignees for the period 1991 – 2011
- ❖ Key inventors, based on the number of IP assets related to power transmission belts are listed in the [Table 1](#)
- ❖ Technology evolutions on the target elastomers, tensile member, surfacing coating/fabric/film and type of belt have been depicted in [Figure 5, 6, 7 & 8](#) respectively
- ❖ Geographical distribution of patent filings related to power transmission belts is depicted in [Fig 9](#)
- ❖ A list of shortlisted patent families along with their detailed information has been presented in the attached Excel report

6. SHORTLISTED DOCUMENTS

Due to large dataset, pertinent patents and applications related to power transmission belts particularly synchronous and v-belts provided in an Excel spreadsheet along with this report. The Excel file contains the following information in detail listed in separate sheets as:

1. Search page
2. Reviewed data extract
3. Shortlisted patents/applications with their family members
4. Shortlisted patent families (one per family) with technology classification, wherein the classification include "Type of Belt", "Type of Polymer (main body)", "Cords/Inserts (strengthen/tensile member)" and "Coating/Film/Fabric (on working surface of the belt)"
5. Shortlisted patent families covering only the target elastomeric materials which include ethylene- α -olefin, nitrile, acrylonitrile, urethane, hydrogenated nitrile butadiene rubber, polyurethane, polyurea and urea
6. Shortlisted patent families covering only the target tensile member made of carbon or graphite fiber
7. Shortlisted patent families only covering a coating/film/fabric adherent to the working surface of the belt in order to ensure the necessary resistance to abrasion and maintaining an adequate flexibility of the belt

7. APPENDIX

Table 2: Search Strings

| # | Search String as of April 30, 2012 | No. of hits* |
|-----|---|--------------|
| 1. | (((power OR energy) AND transmi* AND belt AND ("ethylene-α-olefin" OR ethylene α olefin OR ethylene alpha olefin OR (ethylene <near/3> olefin) OR ethylene propylene OR EPM OR ethylene octene OR EOM OR ethylene octeneterpolymers OR EODM OR EPDM OR ethylene propylene diene monomer OR ethylene-propylene-dieneterpolymer OR ethylene propylene dieneterpolymer OR ethylene butene OR ethylene hexene OR EBM OR nitrile OR acrylonitrile OR cyanoethene OR vinylcyanide OR urethane OR polyurethane OR polyurea OR urea)) <in> (TITLE,ABSTRACT,CLAIMS))) AND (PD>=1991-01-01)) | 402 |
| 1a. | (((power OR energy) AND transmi* AND belt AND ("ethylene-α-olefin" OR ethylene α olefin OR ethylene alpha olefin OR (ethylene <near/3> olefin) OR ethylene propylene OR EPM OR ethylene octene OR EOM OR ethylene octeneterpolymers OR EODM OR EPDM OR ethylene propylene diene monomer OR ethylene-propylene-dieneterpolymer OR ethylene propylene dieneterpolymer OR ethylene butene OR ethylene hexene OR EBM OR nitrile OR acrylonitrile OR cyanoethene OR vinylcyanide OR urethane OR polyurethane OR polyurea OR urea OR HNBR OR HSN OR "hydrogenated nitrile butadiene rubber" OR "highly saturated nitrile")) <in> (TITLE,ABSTRACT,CLAIMS))) AND (PD>=1991-01-01) | 411 |
| 2. | (((Synchro* OR ((power OR energy) AND transmi*)) AND belt AND ("ethylene-α-olefin" OR ethylene α olefin OR ethylene alpha olefin OR (ethylene <near/3> olefin) OR ethylene propylene OR EPM OR ethylene octene OR EOM OR ethylene octeneterpolymers OR EODM OR EPDM OR ethylene propylene diene monomer OR ethylene-propylene-dieneterpolymer OR ethylene propylene dieneterpolymer OR ethylene butene OR ethylene hexene OR EBM OR nitrile OR acrylonitrile OR cyanoethene OR vinylcyanide OR urethane OR polyurethane OR polyurea OR urea)) <in> (TITLE,ABSTRACT,CLAIMS))) AND (PD>=1991-01-01)) | 494 |
| 2a. | (((Synchro* OR ((power OR energy) AND transmi*)) AND belt AND ("ethylene-α-olefin" OR ethylene α olefin OR ethylene alpha olefin OR (ethylene <near/3> olefin) OR ethylene propylene OR EPM OR ethylene octene OR EOM OR ethylene octeneterpolymers OR EODM OR EPDM OR ethylene propylene diene monomer OR ethylene-propylene-dieneterpolymer OR ethylene propylene dieneterpolymer OR ethylene butene OR ethylene hexene OR EBM OR nitrile OR acrylonitrile OR cyanoethene OR vinylcyanide OR urethane OR polyurethane OR polyurea OR urea OR HNBR OR HSN OR "hydrogenated nitrile butadiene rubber" OR "highly saturated nitrile")) <in> (TITLE,ABSTRACT,CLAIMS))) AND (PD>=1991-01-01)) | 505 |
| 3. | (((power OR energy) AND transmi* AND belt AND (graphite OR (carbon AND fiber))) <in> (TITLE,ABSTRACT,CLAIMS))) AND (PD>=1991-01-01) | 53 |
| 4. | (((Synchro* OR ((power OR energy) AND transmi*)) AND belt AND (graphite OR (carbon AND fiber))) <in> (TITLE,ABSTRACT,CLAIMS))) AND (PD>=1991-01-01) | 56 |
| 5. | (((power OR energy) AND transmi* AND belt AND (fabric OR textile OR tooth OR teeth OR cover OR laminat* OR film OR coat* OR woven OR graphite OR (carbon AND fiber))) <in> (TITLE,ABSTRACT,CLAIMS)) AND ((F16G OR F16H 7/* OR F16H 9/* OR B29D 29/*) <in> IC)) AND (PD>=1991-01-01) | 218 |
| 6. | (((power OR energy) AND transmi* AND belt AND (fabric OR textile OR tooth OR teeth OR cover OR laminat* OR film OR coat* OR woven OR graphite OR (carbon AND fiber))) <in> (TITLE,ABSTRACT,CLAIMS)) AND ((474???) <in> NC)) AND (PD>=1991-01-01) | 200 |
| 7. | (((Synchro* OR ((power OR energy) AND transmi*)) AND belt AND (fabric OR textile OR tooth OR teeth OR cover OR laminat* OR film OR coat* OR woven OR graphite OR (carbon AND fiber))) <in> | 254 |

| # | Search String as of April 30, 2012 | No. of hits* |
|----|---|--------------|
| | (TITLE,ABSTRACT,CLAIMS)) AND ((F16G OR F16H 7/* OR F16H 9/* OR B29D 29/*) <in> IC) AND (PD>=1991-01-01) | |
| 8. | (((Synchro* OR ((power OR energy) AND transmi*)) AND belt AND (fabric OR textile OR tooth OR teeth OR cover OR laminat* OR film OR coat* OR woven OR graphite OR (carbon AND fiber))) <in> (TITLE,ABSTRACT,CLAIMS)) AND ((474???) <in> NC)) AND (PD>=1991-01-01) | 239 |

*Databases Searched: US, EP & PCT

IPC & US Class definition:

| IPC | DEFINITION |
|-----------|--|
| F16G | Belts, Cables, or Ropes, Predominantly Used For Driving Purposes; Chains; Fittings Predominantly Used Therefor |
| F16H 7/* | Gearings for conveying rotary motion by endless flexible members (specific for conveying rotary motion with variable gear ratio or for reversing rotary motion F16H 9/00; endless flexible members per se, e.g. belts or chains F16G) |
| F16H 9/* | Gearings for conveying rotary motion with variable gear ratio, or for reversing rotary motion, by endless flexible members (control of change-speed or reversing-gearings conveying rotary motion F16H 59/00-F16H 63/00; endless flexible members per se, e.g. belts or chains F16G) |
| B29D 29/* | Producing belts or bands [4] |
| US | DEFINITION |
| 474 | Endless Belt Power Transmission Systems or Components |

Keywords:

- power, energy, transmission, synchronous, belt
- ethylene- α -olefin, ethylene propylene, EPM, ethylene octene, EOM, ethylene octeneterpolymers, EODM, EPDM, ethylene propylene diene monomer, ethylene propylene dieneterpolymer, ethylene butene, ethylene hexene, EBM, nitrile, acrylonitrile, cyanoethene, vinylcyanide, urethane, polyurethane, polyurea, urea, HNBR, HSN, hydrogenated nitrile butadiene rubber, highly saturated nitrile
- carbon or graphite fiber
- fabric, textile, tooth, teeth, cover, laminate, film, coat, woven

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